ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE,

BOMBAY PRESIDENCY,

FOR THE YEAR

1911-1912.

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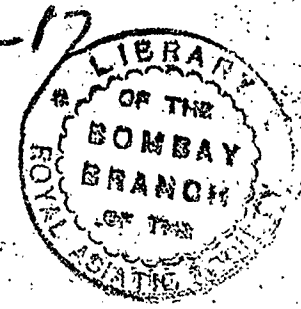

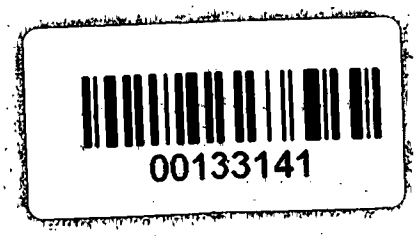

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BOMBAY
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BOMBAY BRANCH

OF THE

Royal Asiatic Society.

No. A.—7324 of 1912.

From

W. W. SMART, Esq., B.A., I.C.S.,
Acting Director of Agriculture, Bombay,
Poona;

To

The CHIEF SECRETARY to GOVERNMENT,
Revenue Department, Bombay.

Poona, 11th October 1912.

Sir,

I have the honour to submit the Annual Report of the Agricultural Department for the year ending 30th June 1912.

CHAPTER I.

Administration.

2. Mr. G. F. Keatinge was Director of Agriculture till 17th November 1911, when he handed over charge to me. The other posts held by Gazetted Officers were as follows:—

Not connected with the Agricultural College.	Connected with the Agricultural College.
1. Mr. T. F. Main, Deputy Director of Agriculture, Bombay Presidency.	1. Dr. H. H. Mann, Principal, Agricultural College and Agricultural Chemist.
2. „ G. S. Henderson, Deputy Director of Agriculture in Sind.	2. Mr. J. B. Knight, Professor of Agriculture.
3. „ A. A. Musto, Agricultural Engineer.	3. „ W. Burns, Economic Botanist.
4. „ B. M. Desai, Divisional Inspector of Agriculture, Northern Division.	4. Rao Saheb G. K. Kelkar, Assistant Professor of Agriculture.
5. „ P. C. Patil, Divisional Inspector of Agriculture, Central Division.	5. Mr. H. M. Chibber, Assistant Professor of Botany.
6. Rao Saheb M. L. Kulkarni, Divisional Inspector of Agriculture, Southern Division.	6. „ S. L Ajrekar, Assistant Professor of Mycology.
7. Mr. V. H. Gonehalli, Divisional Inspector of Agriculture for Konkan.	7. „ S. B. Butani upto May 11th, 1912, and „ S. S. Godbole from 1st June 1912, Assistant Professor of Physics and Mathematics.

Mr. G. S. Henderson enjoyed leave for two months from 31st October 1911 and visited the cotton tracts of the United States of America. He has published an interesting description of his visit. Mr. A. A. Musto was on privilege leave for three months from 5th August 1911 and privately studied steam ploughs in England. Mr. Burns was absent on privilege leave from 29th March 1912 and Mr. P. C. Patil left for a tour in Europe on 23rd March 1912 and enjoyed privilege leave for two months when he was succeeded by Mr. K. T. Shinde. Except in the case of Mr. Musto, the places of these officers were filled temporarily by their subordinates.

3. In addition to the above officers Mr. G. D. Mehta, Supernumerary Agriculturist, continued his researches into the seed supply of the Ahmednagar District. Before his transfer to the Central Provinces on 31st May 1912 Mr. Mehta devised an apparatus for cleaning cotton seed which is likely to be useful.

Mr. T. Gilbert, Supernumerary Agriculturist, was placed at the disposal of this Department from 23rd February 1912. After a short period of training under Mr. Main he was placed in charge of Dhárwár, Belgaum and Bijápur Districts as Assistant to Mr. Main. He appears to be mastering quickly the details of the work of a Deputy Director.

4. The proposal to relieve the Professor of Agriculture of the districts in his charge so that he might devote more time to teaching was not carried out during the year but will be given effect to from 1st October. The hostel for students will be completed about the end of March 1913 and this will facilitate supervision. The staff of the College should then in my opinion be able to tackle the work which they have undertaken and the public demand for the expansion of departmental work in the districts can be satisfied. It is not desirable that further expenditure should be incurred on the College without a thorough enquiry into the necessity for the same. If the expenditure incurred by Government on the education of students in the Agricultural College at Poona were compared with that incurred in other Provinces of India and in England I think it would be found that our expenditure is large. I can state with confidence that the members of the College staff have neglected no opportunity to enlarge their experience by taking an interest in practical and scientific problems of agriculture throughout the Presidency. The danger if any is that the extension of their activities in this direction may interfere with their primary duties of teaching.

5. The character of the season has not prevented considerable progress being made in the work of the Department in the districts. It must be recognised that tracts blessed with certain rainfall or protected by irrigation provide the most promising field for improvements in agriculture. Agricultural stations, except for the purposes of experiments in dry farming, cannot meet with much success in tracts which are subject to repeated years of scarcity. The experiments on such stations are spoiled by constant failure of crops which makes them equally useless as sources of seed supply. Improved methods cannot be introduced into such tracts owing to the inefficiency of the plough bullocks and the lack of capital.

Sind and the Konkan are the parts of the Presidency which are practically immune from scarcity and it is satisfactory that the Alibag Farm has been put into working order and that stations have been started at Larkana and Landhi. The site of the Larkana Farm has been well selected. It is situated two miles from the town and on a main road, and contains a sufficient area of land suitable for kharif crops, rice and "bosi" cultivation. The last is possible only in land retentive of moisture and capable of being reduced to a fine tilth so as to preserve a surface mulch. Such land grows wheat and other rabi crops with the watering it receives at the end of September and the beginning of October. The farm will therefore reproduce all the conditions of cultivation which exist in the rich agricultural district of Larkana and in Upper Sind generally. The Landhi station has been selected for experiments in potato growing and in garden cultivation and will serve as a centre for the increasing area of garden crops round Karachi.

With the exception of a cattle breeding station Sind is now supplied with sufficient stations to meet its requirements for some years. Further expansion must take the form of increasing the number of sub-stations, but in the absence of Sindhi graduates it will be necessary to recruit practical men who have received some training on our farms. It is hoped that such men will be found amongst the scholars at the new Mirpurkhas school. In the Central Provinces men of this class have been used with much success.

The staff in the Konkan has been increased by the appointment of a Superintendent on the Alibag Farm and of one fieldman to assist the Divisional

Inspector. The latter's head-quarters have been removed from Bassein to Ratnágiri where there is much demand for his services. The proposal to place the Konkan in charge of an Extra Deputy Director has been sanctioned and will be carried out from October 1st. Mr. Main, the Deputy Director of Agriculture, will from the same date be relieved by Mr. Gilbert of the Southern Marátha Districts and of Sátára and Sholápur.

It is hoped that the redistribution of charges which has interfered with the training of the subordinate staff and of agricultural progress for a long time will effect vast improvements. With very few exceptions, the graduates have continued to show no power to develop any original line. Whether this absence of the power to specialise in any particular branch of study is inherent in the minds of the students remains to be seen. I am told by the Professors of the College that it is exceedingly rare to find any student who shows any exceptional aptitude for any particular subject. At Colleges in England the best men usually develop an interest in some special line of study before they have passed their examinations. The best men trained by Mr. Mollison are administrators rather than scientists or scientific observers. If the graduate staff on our stations fail to develop under the increased supervision and attention which they will now receive, only one course remains: to increase the European and Indian specialist staff on large salaries and to reduce the number and pay of the ordinary cadre of graduate fieldmen.

The graduates in this Presidency receive an education at the College and salaries in the Department which are comparable to that of the Irish Department of Agriculture, for instance, and better things must be expected from them.

The Deputy Directors have been requested to encourage the superintendents of farms to require from each graduate under him special knowledge in some particular branch of work. It is proposed also to select as far as possible graduates in training for aptitude in some special branch of study, and if scholarships for post-graduate study could be established it would perhaps be possible to ensure the recruitment of men who have not merely succeeded in passing examinations but whom we know to possess the power of conducting scientific work. In England the development Commission has increased lately the number of such scholarships at the principal colleges and universities by liberal grants and there can be no doubt that the aid has been granted on sound lines.

CHAPTER II.

Agricultural Education.

6. The inconvenience caused by the delay in the completion of the College hostel is expected to cease before the end of March. The Principal's report shows that the number of students attending the College has been maintained. I am pleased to note that the number of Mahomedans has increased and that the short course is more popular than last year. The percentage of passes in the examination for Bachelor of Agriculture has fallen from 90·9 to 81·5, but that for the first and second examinations in Agriculture has risen considerably.

7. I have been much pleased with the general tone and the intelligence displayed by the students on the occasion of my visits to the College. The students are drawn from many classes of the community and the state of the College reflects much credit on the staff. Some difficulty was experienced in obtaining a sufficient number of scholars of the Agricultural class, but it is hoped that this is temporary. The difficulty is most marked in Sind and the question has been under discussion with the Commissioner who is of opinion that more attractive careers are open to the limited number of Sindhis who possess the enterprise and the ability to aspire to a University degree.

8. The Agricultural school has not been removed from Poona to Loni because the Public Works Department failed to carry out the work and the allotment for the purpose lapsed. However the work has been carried on at Poona and the College Farm has provided the boys with plots for cultivation.

The condition of these plots is evidence of the excellent teaching received and the boys handle implements and do farm work with skill. It must however be remembered that all the boys are being educated and fed at Government expense for two years and so long as that is the case it is impossible in my opinion to say whether the school is a practical success or not.

The initial outlay on the Loni school is to be Rs. 26,000 and the annual upkeep is to amount to Rs. 6,000. Calculating interest on the first at 4 per cent. Rs. 1,040 and adding this to the latter the cost of educating a boy for two years amounts to Rs. 400. It is obvious that Government cannot increase largely the number of such schools as the cost would be prohibitive; and the question is whether the number of scholars turned out can ever be sufficiently large to effect an improvement in the agriculture of the Deccan. At any rate it is essential that a record should be kept of the after career of every boy who leaves the school, so that we may know what practical value Government has received from his education. If the boys do not improve their own lands and thus disseminate the knowledge of agricultural improvements, the money spent on them is wasted. It must be recognised that the real experiment which the Department has undertaken is not completed by demonstrating the fact that boys can be attracted to such schools by liberal scholarships and given a sound education. I expect more satisfactory results from the school to be built at Devi Hosur in Dhárwár District. The school house and all the land have been handed over permanently or for a period of years to the Department by private persons, and the Lingayat and Raddi communities will provide most of the scholarships. The expenditure incurred by Government will be small and the demand for the school is spontaneous. If the Loni and Devi Hosur schools are successful, I think new schools should be opened only in places where the demand for them is obviously genuine.

9. The short courses instituted last year have not been successful. Only one out of six applicants attended the short course at Manjri Farm. This may have been due to changing the date from January to April. No one appears to have attended the short courses under the direction of the Deputy Director and the Economic Botanist.

10. I will close this chapter with a few general remarks on the subject of agricultural education. The subject of education is receiving much attention from Government and the public at the present time. During my tour in Europe from August to October 1911 I made enquiries into the subject of agricultural education in Ireland, Belgium, France and Italy. In these countries and in others where the supreme importance of agriculture to the welfare of the nation is being realised, attempts have or are being made to lay the foundations of a consistent system of education designed to meet the requirements of the rural population. The first principle on which the systems are based is the necessity for complete co-operation between the ministries of public instruction and agriculture. In France laws have lately been passed to give effect to this principle and to place the provision for the education of the rural community on a level with that of Germany and other countries.

The question of education in rural schools has been the subject of discussion in this Presidency and it appears to me that the discussion was diverted from profitable lines by the somewhat absurd idea that some one wished to teach agriculture in primary schools. Agriculture cannot be taught in a primary school any more than could any other practical art. What every country interested in the welfare of the rural classes is providing in primary schools is an education in the elementary principles of the sciences which underlie agriculture and with simple object lessons to illustrate these principles. In Belgium I saw a rural school where such education is imparted and the whole system was explained to me at length. The Belgian Government has insisted on the divorce between urban and rural teaching and the training and career of the masters destined to teach in the town and the country is separate from the start. The education imparted in rural schools is imbued with the tone and interest of the country. The schools are visited and examined regularly by officers of the Department of Agriculture. Secondary education is or has been provided in most of these countries by itinerant agricultural teachers

and farm institutes for imparting a sound practical training. Higher education in agriculture is provided at Colleges and Universities, but it is recognised that the agricultural scientist must study and possess a thorough acquaintance with the agricultural practice of the tract of country in which his activities lie so that he may be in a position to attack the problems presented to him. In short, the principle that the sciences underlying agriculture must for the purpose of successful application be brought to bear on the strictly local problems of agriculture, is recognised. To minimise expense the ministry of Public Instruction places all facilities as to the use of buildings, etc., at the disposal of the officers of the Agricultural Department and the two departments work hand in hand.

This Presidency possesses a splendidly equipped Agricultural College; secondary schools are being started, but there is no provision for imparting instruction by itinerant agricultural teachers and a properly organised system of agricultural education has not been worked out. More co-operation between the Educational and Agricultural Departments appears to me to be desirable. An officer of the Educational Department of the Central Provinces was studying agriculture at Cambridge with me and I gathered that the question was receiving the full attention of the Government of that Province.

CHAPTER III.

Research and Experiment.

11. It is natural that the expert officers of the Department, especially those engaged in Administrative work, have not much time to devote to research. What progress has been made is described in the appendices to this report. I will, however, mention the lines which the more important research work has taken for the benefit of those who desire to study the questions in detail.

The Agricultural Chemist and his staff are continuing the investigation of the chemical and physical effects of the "rab" process. It seems desirable that the researches in this direction should, if arrangements can be made, be supplemented by bacteriological analysis. The study of the occurrence of salt effiorescence in the black soils of the Presidency has continued, but Mr. Henderson in Sind appears to have proved that in Sind the evil can be overcome by a carefully designed system of drainage on the Egyptian model. Mr. Henderson's final report on the reclamation of 400 acres of the worst kind of salt land has been forwarded to Government and will be published shortly as a bulletin.

It is hoped that the investigation into the properties of safflower oil will lead to some useful results. There is much research work to be done on the oils obtained from our numerous oil-seed crops.

The Economic Botanist and his staff have confined their researches chiefly to an examination of the varieties, insect and fungoid pests, and systems of grafting, of the mango. The survey of the varieties of rice in the Presidency has been continued and will take some years to complete.

It is hoped that it will be possible in the future for the staff to devote more time to staple crops. The energies of the Economic Botanist and his staff have been given for the past few years mainly to fruit trees and much valuable work has been the result. The system by which land and the staff of the Alibag Farm are being utilised to assist the researches on rice is one which is capable of development. The graduate staff on the experimental stations should be capable of assisting in the carrying out of Botanical researches.

12. The experimental work carried out on the Agricultural Stations is described at length in the Annual Report of each station and has been summarised by the different officers in charge of them in their summaries of the year's work appended to this report.

It is unnecessary to repeat the description of these experiments, but a general review of the position in which the Department now stands and some indications of the lines in which future development is probable will not be out of place.

Much work has been done in improving the quality and outturn of the cottons of the Presidency and in testing the value of exotic varieties.

In Gujarát the Department has obtained by selection and hybridisation cottons which are superior in quality to those grown by the cultivators and which are not inferior in yield. The value of these cottons is about 10 per cent. greater and the Bombay Millowners' Syndicate guaranteed a price 5 per cent. higher than the ordinary market rate of cotton sold round Surat.

In Khándesh the Department has selected from the mixed varieties sown a pure variety which gives a considerably better outturn and has a brighter and more attractive colour. The possibility of growing Broach cotton from Navsari in many parts of the Dhárwár District has been proved. The quality of this cotton is superior to Kumpta and the outturn is better owing to its higher ginning percentage and slightly superior yield. In certain tracts of the same district the superiority of Cambodia cotton to Dhárwár-American has been demonstrated. The obvious advantages in every respect of this cotton over Dhárwár-American and the very high prices obtained have created a great demand for the seed.

Mr. Main's report on the subject of all these cottons is worth a careful perusal and his estimate of the probable increase of wealth to the Dhárwár District by its introduction is none too high. It may be remarked that his estimate of 16 lacs is more than the land revenue of the whole district.

Such results when fully realised will do more to justify the existence of the Agricultural Department and the need for liberal expenditure on experimental work than general reports of progress in improved methods.

In Sind the possibility of growing certain varieties of American cotton superior to middling has been conclusively proved by experiments carried out on the Mirpurkhas station and repeated on the other stations and sub-stations of the province. The success of these cottons in Upper Sind where previously very little cotton has been grown is a most important fact. Arrangements were made in the course of the year to import 40 tons of seed of the "triumph" variety for sowing in May and June 1912, but owing to a succession of unforeseen troubles in the railing and shipping of the seed the experiment of growing the cotton on a large scale has been postponed. A working agreement has been arrived at with a Syndicate formed by the leading representatives of the Bombay Cotton Trade whereby the Syndicate undertakes to set up ginning and buying centres in two or three places in Sind. The cultivators are to be paid on the basis of the grading of samples sent to Liverpool for the purpose less deductions on account of freight, ginning and pressing charges, etc. The cultivators will receive part payment on delivery at the gin according to the price of middling American cotton quoted at Liverpool and the balance after the result of the grading is known. The operations under this agreement are to be carried on for two years, arrangements being made by the Syndicate for the expansion in the second year.

The agreement is an important departure in the attitude of the cotton trade in India towards high grade cotton and is the first attempt of the trade in this Presidency to come into touch on a large scale with the cultivators.

The testing of new varieties of cotton will proceed, but the energies of the officers of the Department will be specially devoted to spreading the growth of the above cottons in the tracts suited to them. This will be referred to in the next chapter.

13. The experiments of the Department in the growth of sugarcane have been carried on for many years at Manjri station and the following important results have been obtained:—

(1) The cultivator appears to use from $\frac{1}{4}$ to $\frac{1}{2}$ more water than is necessary per unit of area.

(2) The cultivator applies about 600 lbs. of nitrogen per acre, but equally good results can be obtained with 350 lbs.

(3) Half the quantity applied as nitrogen in cake manures can be more advantageously given in the form of sulphate of ammonia.

(4) By the improved furnaces designed by the Department for boiling sugarcane juice, refuse and trash, valuable as organic manures, can be saved.

The points on which further experiments appear to be required are the effect of different manures on the quality of raw sugar and the selection and cutting of sets.

The necessity for an investigation into the causes which affect the keeping quality of "gul" and for an extended analysis of the fibre content of the varieties grown in different parts of the Presidency, is also indicated.

14. Experiments on other crops except groundnut have not met with such striking success as those conducted on cotton and sugarcane, and the history of the Department's success in the matter of groundnut was given in paragraph 27 of the last year's report. We still continue to distribute large quantities of seed of foreign varieties in tracts where it is comparatively unknown and the market cannot supply the demand. The success which has attended the experiments in growing groundnut in the *varkas* lands of the Konkan has been demonstrated and the demand for the seed of small varieties in the Ratnágiri District is greater than we could supply. As the Collector has remarked, the Department has succeeded in introducinng into the district a commercial crop which can put money into the pockets of the cultivators.

Steady progress is being maintained in testing varieties of different cereals for quality and outturn. The general conclusion which experiments in cereals tend to demonstrate is, that some variety to be found in the tract, is usually found to be superior on the whole to those imported from elsewhere. This conclusion, however, is a somewhat dangerous one as exceptions may be found.

There is much work to be done on wheat in Khándesh with a view to find a variety which is rust resistant and also a good yielder.

15. The question of fodder has received considerable attention. The value of Egyptian clover in Sind wherever irrigation can be given in the cold weather has been demonstrated in this year of scarcity at Mirpurkhas and Sukkur. The farm cattle throve on the crop and as they are grazed the improvement to the land from their manure is added to the renovating qualities of the leguminous crop.

The demand for lucerne seed was greater than could be met and seed from Quetta was obtained but has not given such good results as the local. It is possible that further experiment may not confirm this result.

The results of experiments in the storage of fodder which have been carried on at the Dhárwár and Surat farms for some years may be summarised as follows :—

The round stack is superior to the rectangular as the quantity accommodated per unit of roof surface is greater and theft is more difficult. Where white ants are feared an effective platform on pillars 2 feet high measuring 21 by 11 feet and sufficient to hold 30,000 lbs. of fodder can be constructed for Rs. 35. Mud plastering has proved the best kind of covering for stacks as a loss of less than 7 per cent. occurred as compared with 10 to 30 per cent. in the case of other methods. A stack of this type cost one rupee per thousand lbs. of fodder to build and cover.

Mr. Main has calculated that assuming the price of 1,000 lbs. of jowár kirbi to be Rs. 6 at harvest in a normal season and that it costs Rs. 1-8-0 to stack on a raised platform and to cover with mud plaster and adding Rs. 1-8-0 as a liberal allowance for loss, it could be sold 18 months after in May or June at a good profit, of one rupee per 1,000 lbs. even in a normal year in Kaira District.

In the Deccan and Southern Marátha Country the profit would generally be much larger and in years of scarcity the profit which could be made would be very large.

The investigation into the question of the best method of compressing fodder has been continued, but samples of karbi sent to England for treatment could not be dealt with properly by existing machines. The question is being further investigated.

16. The Tegur grass farm has been developed to a certain extent during the year. A considerable area has been cleared of scrub growth and stones with little expense to the Department, as charcoal contractors are willing to remove the scrub growth for purposes of their trade. The area so cleared has been cut by a grass cutter and the hay stacked and a hedge has been planted to protect this land.

The farm will serve as a station for the proper treatment and storage of grass as well as for cattle breeding. The amount of waste of valuable fodder which occurs in this Presidency and in many other parts of India is almost incredible. Grass which could serve as a nutritious fodder for cattle is allowed to seed and become fibrous and consequently of little use. In tracts of heavy rainfall this grass could be made into ensilage. In America and Canada the value of ensilage is appreciated and nearly every farm has been or is being provided with its silo. The Indian cultivator who allows his cattle to undergo semi-starvation for 4 or 5 months in the year and thus ruins the constitution of his young stock and shortens the life of his plough cattle, raises objections to the use of silage though it has been demonstrated to him by the Department that cattle will consume it with relish and obtain nourishment from it. The grass imported into Bombay loses half its value because the delay in cutting it has raised the proportion of digestible and indigestible fibre to a percentage which makes the small amount of valuable food constituents allowed to remain more or less worthless. It is not realised that grass allowed to seed and become fibrous loses most of its nutriment, and the little that remains is used up in the energy of digesting the fibre.

An investigation into the feeding value of grass at different stages of its growth is to be carried out and will be accompanied by chemical and botanical analysis.

There is much work to be done in conserving and economising the existing resources of the country as to fodder apart from attempts to meet famine conditions by storing compressed bales.

It has occurred to me that many dry tracts of the Deccan could grow cereals and cut them immature as is done in Australia in tracts where the rainfall is less than 10 inches. A large amount of this fodder is imported in lightly compressed bales for the stables of Bombay. It fetches a high price and is considered the best fodder on the market.

17. The possibility of working a steam ploughing plant in the Southern Maratha Country for the eradiction of deep rooted weeds was further considered. I was not satisfied that the "hariali" grass would die out in land ploughed to 16 inches deep in the same way as it does in the case of hand digging. Consequently the present Bajac plough whose action is similar to that of a steam plough was utilised to carry out experiments on a field infested with the grass. Another Bajac plough was meanwhile ordered from France. The results of these experiments which comprised simple ploughing, ploughing and harrowing to collect the grass, etc., were, as appears from the preliminary reports, entirely satisfactory. The field was ploughed from 2nd November to 21st January and sown with potatoes this season. The crop has been far superior to surrounding crops owing to the draining effect of the deep tillage and the field will according to the owner's own statement cost less than one rupee to handpick after the potatoes are lifted. These results are very important in their bearing on the question of the success of a steam plough because we have proved—

(1) that "hariali" grass can be removed nearly as well with ploughing alone as by hand digging. The difference by actual counts of shoots remaining in the ground at the end of September is negligible compared with the difference in cost of the two operations;

(2) that the land can be worked and a crop can be grown in the kharif season immediately following the operation;

(3) that such crops are superior to those of surrounding lands especially those dug by hand where water collects in the holes made by digging.

It is expected that arrangements to order a steam ploughing plant able to plough 8 acres a day to a depth of 18 to 16 inches deep will be made in a few days. The plant will not be owned by Government, but the management will be in the hands of officers of the Department.

If the experiment or rather demonstration of the profitable use of steam ploughing is successful, and the question of its practicability has been so carefully considered from every point of view that there is little doubt as to its success, then I anticipate an enormous extension of the system not only on weed-infested lands but for sugarcane tracts.

Deep black cotton soil is almost ideal for treatment by steam tackle. There is no injurious subsoil to be turned over by deep working; the land is practically devoid of scrub growth or rocks which are apt to injure the machinery without careful handling and there is a good return for efficient tillage.

Tillage with indigenous implements is both expensive and inefficient. We hope to demonstrate the fact that it is possible for commercial companies to make a handsome profit out of owning steam tackle. The demonstration is to be carried out on business lines and we have already booked orders provisionally in two villages for sufficient work to last about one year.

18. The experiments in dry farming have given far from conclusive results. From similar experiments in Australia and from Mr. Henderson's account of what he saw in America I am inclined to think that an attempt to mature crops on such a small and ill distributed rainfall as many parts of the Deccan succeed in getting in years of scarcity, is beyond the powers of any system of dry farming, except perhaps with an allowance for fallow every other year. The experiments however will be continued, and it is possible that more success will be attained in areas less liable to extreme drought.

19. Manurial experiments have been continued, but the drought in many cases vitiated the effect of the application to dry crop land of concentrated and forcing manures. Night soil for cotton at Surat and safflower cake with farm yard at Gokak gave excellent results. Trash proved a useful manure for sugarcane; also ammonium sulphate used as a top dressing gave excellent results. It is found generally that the price of artificial manures makes their use unprofitable. Difficulties in the use of green manures for rice in the Konkan have arisen. It is difficult to get a good growth before transplantation when they are sown in June, but the results with san hemp are encouraging. If sown after the rice crop is reaped, cattle eat the green manure in unfenced fields.

20. Experiments in tillage were made to compare the effects of ploughing in the cold weather as against ploughing on the advent of the monsoon rains. Definite results have not been obtained, but the remarkable effect of a combination of tillage and rotation combined is cited by Mr. Main. A jowári crop at Dhárwár following potatoes, the land for which had been well worked and manured, gave an outturn of 1,401 lbs. of grain and 5,363 lbs. of karbi per acre when owing to the poor season 500 or 600 lbs. of grain could be obtained with difficulty. This result tends to show that there is the same necessity for a root crop in the rotation in India as there is in England and other countries where high yields are obtained.

The deep black soils of the Presidency are difficult to work. Professor Knight has tried many implements to render ploughing easier and to reduce the ploughed land to a tilth. The value of disc harrows after harvest for destroying weeds and giving a mulch to preserve moisture and thus make ploughing easy appears to be indicated, but the question of cost arises.

It is hoped that the modifications made in the ploughs of Messrs. Ransomes, Sims and Jefferies as a consequence of the visit of an expert from England who saw the ploughs approved by the Department at work, will make the C. T_2 and Gallow's ploughs even more popular than they are.

It is satisfactory that interest in the question of implements for use in India is being shown by European firms. Except in the lighter soils and sometimes even in them at certain stages of drying, the indigenous implements are as a rule most ineffective and expensive to work. It is a mistake to suppose that they are cheap: the extra bullock power required, the slow rate of working, and the inefficient work performed outweigh the difference in initial cost between them and improved iron implements.

The want of a good and cheap drill is felt badly. Trials with some American drills have given good results, but the cost is somewhat high. Of indigenous drills those used in Gujarát appear superior to any others. An attempt to introduce these into the Southern Maratha Country has not been altogether successful owing to the trouble entailed in training the bullocks.

Apathy, want of capital and distrust of new methods are more apparent in the matter of the introduction of new implements than of other improvements. The Department in order to meet well-known objections to the use of the improved implements keeps a large stock of spare parts and demonstrates their proper use.

CHAPTER IV.

Shows and Demonstration, Aid to the Public, Agricultural Associations and General Progress.

21. During the year under report only 11 shows and demonstrations were held. Many which had been proposed were abandoned owing to the unfavourable season. The shows at Kumta, Varsoli and Ratnágiri were the most important and were well organised and attended. It is the policy of the Department not to encourage large shows unless there is a genuine demand for them and it is desired to awaken general interest in definite improvements which the Department can recommend. Such shows are useful where the activities of the Department are not well known and there is a desire amongst the progressive agriculturists to form an association. Generally however large shows are apt to cripple the slender resources of agricultural associations, and to cause money to be lavished in display which might be spent on more useful and practical work.

Demonstrations accompanied by the grant of prizes for produce when held in conjunction with existing fairs or horse shows serve the purpose of bringing to the notice of a large number of cultivators assembled at such gatherings, the improvements which the Department desire to advertise. Such demonstrations were held at Badin and Naushahro Feroz in Sind.

The demonstration held on the Government farm at Surat in November 1911 was attended by 600 cultivators. The lectures and demonstrations, of ploughs, chaffcutters, etc., were appreciated. The support of the district officers added to the success attained.

Cultivators from Násik, Sátára and Sholápur districts were entertained at a demonstration arranged at the end of October 1911 on the College and Manjri farms. They were shown the arrangements for conserving cattle manure, the improved furnaces for boiling sugarcane juice, and the stock at the Dairy amongst many other things. The meeting appears to have produced a good effect and served to popularise the work of the Department and produce cordial relations between officers of the Department and the cultivators.

22. The most important problem which the Department has to work out, is the organisation of a comprehensive system by which the cultivator can be reached and influenced.

At present our efforts in this direction have been isolated and more or less tentative, and have been hampered by the postponement of the rapid expansion of the district staff owing to the demands on the budget caused by the provision for the Agricultural College and its buildings.

During the year however the following important organised work of this nature was carried out.

In accordance with the arrangement made with the Syndicate formed by the leading merchants of the Bombay cotton trade, the Department distributed 60 tons of seed to sow over 11,000 acres. It had been stipulated that the quantity of cotton supplied to the Syndicate should not be less than 2,000 bales. Owing to the exceptionally bad season only 1,167 bales were delivered at the gins which also served as buying centres, but the Syndicate raised no objection on this score to the payment of the 5 per cent. above market rates. The seed after ginning was placed at the disposal of the Department and has been available for distribution this season. Difficulties and objections to the arrangements made on the cultivators' behalf were raised but were mostly overcome and this year the main objection which was to the long distances for carting to two gins only will be obviated by selecting a larger number of gins.

A system by which these selected cottons will be distributed more rapidly has been devised. It consists in dividing villages into groups and providing one group with seed grown departmentally and allowing another to obtain seeds from that group in the following year. Thus a large area will be grown every year with selected seed grown by the Department, but the results of such sowings will be available to an ever-increasing circle of villages. The selected seed shows little appreciable deterioration in two or three years and will be renewed constantly from the centre of the circle.

The operations round Surat necessitated the appointment of a temporary establishment to aid the Divisional Inspector of Agriculture, Northern Division, in the work of distribution and supervision.

The auction sales organised by the Department at Dhárwár and Gadag for the sale of Broach cotton, and at Gadag for the sale of Cambodia cotton were well attended by representatives of the cotton trade from many centres. The prices obtained were very high especially for Cambodia. The Department distributed 30,000 lbs. of Navsari (Broach) seed alone. The popularity of the auctions is well established, and the metods of conducting them have been demonstrated. It is time that the people themselves took an active part in the conduct of the sales, and relied on the Department merely for testing a certain percentage of the grading which ought to be performed by a committee of their own. In this Presidency it is unfortunate that the hiatus between departmental experiment and the adoption by cultivators of those that are proved a success, is always difficult to fill. The paucity of large landholders with a reputation to lose and the consequent absence of leaders and the presence of distrust of one another which prevails amongst the cultivators are the greatest bars to concerted action. The Co-operative Societies are not yet sure of themselves, and shrink from anything requiring business ability. It is the prevalence of the small landholder which makes progress in this Presidency slow as compared with other provinces.

23. The question then arises as to whether it is possible to effect a more rapid introduction of improvements through the medium of agricultural associations and to bring the latter into touch with Co-operative Societies.

The Deccan Agricultural Association has exhibited increased activity during the year. Since January it has appointed an itinerant organiser lent by the Department in order to carry out demonstrations, induce associations to become affiliated with it and to visit the Co-operative Societies of the Deccan.

The appointment of this organiser meets a want felt by all associations and that is the absence of any expert and paid staff. It has, however, been a strain on the resources of the association, and if the organiser's appointment is to be continued it will probably be paid for from capital. This is the second weakness of associations, and they may be said to be so intimately connected that they cannot be separated.

The question then remains how in the absence of staff or funds, associations are to help the work of the Department. I am not entirely hopeless of using the associations profitably. When addressed with a view to their members

offering small plots of land for demonstrations many associations have come forward with offers, and some plots were laid out and are to receive occasional supervision from officers of the Department. This is a useful piece of work which the associations can carry out without cost and by the public spirit of some of their members, but whether the result will be superior to what could have been achieved by the Department through the individual members apart from the association, is a question which can only be decided by experience.

Personally I feel that if the Department is to rely on the help of associations in this Presidency for the spread of the knowledge of improvements, then the progress must and will be slow, and spasmodic. No sustained and regular effort can be expected from associations without funds and without staff. I am only surprised that so much money and such energy, occasional it is true, have been forthcoming.

I am convinced that some organised system similar to that adopted in Ireland where the conditions resemble those of this Presidency, is necessary. In Ireland the County Council levies a small cess on the rateable value of holdings and receives a contribution from the Department of Agriculture in proportion to its amount. The money so provided is placed at the disposal of a County Committee formed from members of the Council and others coopted.

The Committee appoints its own Secretary and obtains its expert staff from the Department which controls them. The Committee receives the grant from the Department on condition that it confines its activities to one or more of the schemes laid down to be followed.

These schemes include a system of itinerant teaching, horse, sheep and poultry breeding, etc. The principle underlying the whole organisation is that Government should give assistance only in proportion to the interest displayed by the people in each locality, and the test of this is their willingness to levy a small cess. There is no doubt that the measure has met with great success and has been of immense benefit to the country. I studied the theoretical and practical aspects of it in August and September 1911.

24. It was suggested in last year's report that a way out of the difficulty of providing funds for Agricultural Associations might be found in converting Co-operative Credit Societies into Agricultural Associations on the French model. But the history of the French system appears to me to be no guide to conditions in this Presidency. The French law enacts that no one can be a member of a Co-operative Credit Society who is not a member of a "Syndicat Agricole." The French authorities kindly explained the meaning of this enactment to me. The "Syndicat Agricoles" arose naturally and have been in existence for nearly a century, and were formed to supply farmers with fertilisers, machinery and with insurance against loss from diseases of stock, etc. It was considered desirable to graft the Co-operative Credit movement on the old established organisations represented by the "Syndicat Agricoles."

Both Co-operative Credit Societies and Agricultural Associations are in this Presidency of recent growth and have been brought into existence and fostered by official means. The Credit Societies have scarcely found their feet and are with one or two exceptions engrossed in the question of obtaining cheap money. However one Society, that of Hadapsar, a village close to Poona, applied to me for aid in buying manure for sugarcane. With the help of Professor Knight and Dr. Mann I was able to obtain fish and cake manure supplied at a reduction on the market rate and on samples which were analysed. The bulk according to the contract was to be upto sample or a reduction in price was to be made. The Society managed the details of ascertaining the requirements of their members and the distribution and it had enough money to pay cash. It has joined the Mutha Canal Manure Supply Association which has applied for registration under the New Co-operative Act and has been organised under the auspices of Dr. Mann and the Deccan Agricultural Association's Executive Committee.

Mr. Herlekar of Dhárwár is organising a society for the purchase and distribution of the cotton seed of the Department. There is therefore some

sign that some of the progressive Co-operative Credit Societies are willing and ready to take advantage of the help the Department can give.

Every effort has been made to bring the officers of the Department, the Agricultural Associations and the Co-operative Credit Societies into touch with one another. I have arranged to supply Co-operative Credit Societies with leaflets and the Marathi and Kanarese editions of the "Shetki and Shetkari" published under the auspices of the Deccan Agricultural Association and Dhárwár Agricultural Association respectively but really written and edited by officers of the Department.

A Co-operative Manual has been in the course of preparation by the Registrar and the lines of organising Co-operative Societies for the supply and sale of agricultural requirements and produce, have been discussed with the Registrar by Mr. Main and myself. It is hoped that some definite results will ensue from these combined efforts to promote progress.

Mr. Main has induced the Agricultural Associations of East Khándesh to establish seed farms to act as centres for the distribution of pure "roseum cotton," but difficulties are likely to arise as to the ginning.

25. The following new Agricultural Associations came into existence during the year :—

(1) Táluka Agricultural Association, Bársi in Sholápur District.

(2) Agricultural Association at Shrigonda in Ahmednagar District.

(3) Shetki Sabha at Paud, Peta Mulshi in Poona District.

(4) Agricultural Association at Bhingar, táluka Nagar, Ahmednagar District.

(5) Táluka Agricultural Association of Málegaon, Nasik District.

(6) Agricultural Association at Saswad, Poona District.

(7) Táluka Agricultural Association of Karjat, Ahmednagar District.

These bring the total number of associations up to 45.

CHAPTER V.

Agricultural Engineering.

26. In Appendix H the Agricultural Engineer has given a summary of the work of the year. The insufficient supply of water in most of the wells of this Presidency has prevented the extension of pumping plants to them to the extent to which this has occurred in Madras.

It is hoped that the newly designed pump of Messrs. Gwynne will obviate the difficulty and the use of portable oil engines to work more than one well as is done on the Dhárwár Farm may become popular in Gujárat.

It is satisfactory that the two pumping plants at Ghotavada have been bought from the Department. When they were worked by us the owners of lands which could be irrigated by them let most of the water run back into the river. Now that the plants are owned by private persons I have no doubt that this waste will not occur. The Department has gained the experience that what is not paid for is regarded as worthless.

The installation of the large suction gas plant at Nangaon on the Bhima has from an engineering point of view proved a success. It has stood the test of the exceptional floods experienced this season. The Irrigation Department has undertaken the distribution of water. I hear that the people who cried out to me for water when I visited the plant are now hanging back, no doubt with the idea that water will be given free as at Ghotavada. The Department however can afford to wait.

The erection of this plant reflects the greatest credit on Mr. Musto.

27. The number of boring sets in the possession of the Department during the year was 28, but at the close of 1911, ten sets were handed over with one boring Assistant to the Kaira District Local Board. The number of failures was larger, because at the urgent request of the Collector of Kaira sets were transferred from tracts where water was expected to be obtained to others where success was doubtful. The demand for drinking water made the transference necessary.

The working of the sets has been appreciated as is shown by the fact that 14 have been purchased by private owners.

The Agricultural Engineer examined the working and has suggested various improvements which, if successful, will lead to much quicker and more efficient work.

This year the establishment is to be transferred to the Agricultural Engineer as the nature of the work requires engineering knowledge.

28. Further experiments have been carried out to test the value of the water finder. A bulletin giving the results is to be published shortly, and I prefer to say nothing further on the subject until these results are known.

CHAPTER VI.

Publications.

29. The following publications have been issued since those mentioned in the last year's report :—

Bulletins.

(1) Bulletin No. 50 of 1912—An examination of the seed supply of the Ahmednagar District, Part II.

(2) Bulletin No. 51—Third year's experiments in the treatment of grape vine mildew.

(3) Bulletin No. 52—Muscovado sugar machinery and its scope for gul manufacture in India.

(4) Bulletin No. 53—A method of improving the quality of cotton seed.

Leaflets.

Leaflets (with vernacular versions).

(1) Leaflet No. 8 of 1911—On iron mhot.

(2) Leaflet No. 1 of 1912—On treatment of a mango plantation.

(3) Leaflet No. 2—On how to grow pomegranates.

(4) Leaflet No. 3—On treatment of grape vine mildew.

(5) Leaflet No. 4—On hints on grafting.

(6) Leaflet No. 5—On sulphate of ammonia as a manure for sugarcane.

(7) Leaflet No. 6—On cultivation of Cambodia cotton in the Southern Maratha Country.

30. The Broach District Agricultural Association have published bulletins in Gujarati based on material supplied by the Department. It is hoped that this will develop into a monthly periodical in that language.

Much could be done if every vernacular paper having a circulation in the mofussil reserved a column or paragraph for agricultural news. There is plenty of material obtainable from Departmental publications, etc.

CHAPTER VII.

Miscellaneous.

31. The amount of work which falls on all officers of the Department is very great, and the College and district officers have performed it with zeal and efficiency.

Mr. Main's duties have been particularly arduous and I am glad to say that the accessibility of his new charge will eliminate many of the unpleasant features.

I have the honour to be,

Sir,

Your most obedient servant,

W. W. SMART,

Acting Director of Agriculture.

APPENDIX A.

No. 2299 OF 1912-13.

Poona Agricultural College,
Poona, August 13th, 1912.

From

HAROLD H. MANN, D.Sc.,
Principal, Poona Agricultural College :

To

THE DIRECTOR OF AGRICULTURE, BOMBAY,
Poona.

Sir,

I have the honour to submit herewith the Report of the Poona Agricultural College for the year ending June 30th, 1912.

COLLEGE BUILDINGS.

2. The year under report is the fourth since the establishment of the College as a eparate institution, and is the first in which the College has been fully accommodated in its new buildings. The main college block was opened by His Excellency Sir G. Clarke on July 18th, 1911. During the year the building of the College hostel has been taken in hand and is making good progress.

UNIVERSITY AGRICULTURAL COURSE.

3. The new agricultural course sanctioned by the University Senate in November 1909 has come into full operation during the college year under review, and is on the whole satisfactory.

SHORT COURSE.

4. The short course, started three years ago, as an addition to the college work, is intended for farmers' and landowners' sons. For this the sole qualifications were that the student should know English and have a fairly good general education. The training given is essentially a practical one, and is designed to give the men as good an acquaintance as possible with the best methods of agriculture applicable to our areas. There was at first some doubt as to whether there was a real demand for this course, but this is now entirely dissipated, and the number of the suitable students tends to increase. The actual number of students attending the course has been as follows:—

1909-10	4
1910-11	12
1911-12	13
1912-13	15

COLLEGE STAFF.

5. The staff of the College has suffered two losses during the year. Mr. S. B. Butani, M.A., B.Sc., who only joined us as Assistant Professor of Physics and Mathematics in June 1911, was compelled for family reasons to resign his position and return to Karáchi in May 1912. During his time with us Mr. Butani had shown great energy and skill in teaching, and also was carrying on investigations into the mechanics of agricultural implements which were of very promising character. His leaving is a serious loss to the staff. His place has been taken by Mr. S. S. Godbole, L.C.E., who gives promise of good and satisfactory work.

Mr. C. V. Sane, B.Ag., who had been Assistant Superintendent of the College Farm and Demonstrator in Agriculture for three years, left us in May to join an appointment in the Baroda State. His place has been taken by one of the most promising of our recent graduates, Mr. B. S. Patel, B.Ag.

Professor W. Burns was on privilege leave from March 29th to June 29th, 1912, during which time his place was taken by Mr. H. M. Chibber, M.A., the Assistant Professor of Botany. The latter displayed energy and devotion in carrying on the duties of his chief during the latter's absence.

Mr. D. D. Sanga, G. B. V. C., Lecturer in Veterinary Science, one of the oldest members of the college staff, went on long leave for one year on June 1st, 1912, and his place has been takeen by Mr. F. Gracias, G. B. V. C., the Demonstrator in Veterinary Science. The latter's place has been filled by Mr. B. B. Joshi, G. B. V. C., who has been seconded from the Civil Veterinary Department for the purpose.

STUDENTS.

6. The number of students this year is exactly the same as in the previous one. The actual figures for the past five years have been as follows:—

	1908.	1909.	1910.	1911.	July 1912.
First year students	31	38	36	38	38
Second year students	39	26	33	24	27
Third year students	34	39	27	28	22
Short course students	...	4	12	13	15
Special and post Graduate students ...	...	1	2	1	2
Total ...	104	108	110	104	104

The students during the last four years included in the above table have come from the following parts of India:—

	1909.	1910.	1911.	1912.
Bombay Presidency — Deccan	34	32	28	28
Bombay Presidency — Southern Maratha Country and Konkan	32	35	34	25
Bombay Presidency — Gujarát	17	18	23	25
Bombay Presidency — Sind	9	6	4	6
Eastern Bengal and Asam	10	8	2	...
Central Provinces	...	...	1	...
Bengal	2	2	1	...
Central India	1	...	...	3
Nizam's Dominions	2	4	2	2
South India and Ceylon	1	5	9	14
Burma	...	...	...	1

Arranged according to the castes or classes from which they come, the students stand as follows:—

	1909.	1910.	1911.	1912.
Bráhmins	68	64	54	45
Maráthas	4	5	8	4
Lingáyats	5	6	5	2
Pátidárs (Gujarát)	4	5	4	3
Mahomedans	7	7	4	10
Pársis	1	2	4	9
Eurasians	...	...	...	1
Others	19	21	25	30

7. These students may be divided into three classes:—

(*a*) By far the larger number are qualified to study for, and intend to take, the agricultural degree of the Bombay University. The qualification on which the Bombay University insists, namely, the Previous examination or its equivalent, is insisted on in the case of practically all students from the Bombay Presidency itself, and no students can, of course, appear for the University Agricultural degree without it.

(*b*) The second class consists of a few students who are not admissible to the University Examination, but who are taking the regular course along with the first class of students. These exceptions arose from the fact that it has been decided by Government to allow scholars to be received from Sind who have only passed the Matricu-

lation Examination, provided that they were to receive the same course, and pass by the same standard as the University demands. Under this ruling, students have been received every year since 1908. At the same time some applications were received from other Governments in India and Ceylon to be allowed to send students and from private persons outside the Presidency for admission to the College, where the applicants were not fully qualified for the University course. Where there was evidence to show that such students could properly follow the course, a small number have been admitted, as follows:—

	Admitted in 1909.	Admitted in 1910.	Admitted in 1911.	Admitted in 1912.
Bengal	...	...	...	...
Eastern Bengal and Assam...	2	...	...	...
Nizam's Dominions	...	...	...	...
Sind	1	1	1	2
Bombay Presidency and Native States (Subordinate).	...	2	3	...
Ceylon	...	2	...	5
Goa	...	...	1	...

(*c*) In the third place, we have the short course students already referred to. The places from which they come are as follows:—

Deccan	3
Southern Marátha Country	2
Gujarát	6
Nizam's Dominions	2
South India	1
Central India...	1

As has already been stated, all these are the sons of landowners, and are taking the course for the sole purpose of putting their training to advantage on their own lands.

8. In addition to these classes, we are being occasionally requested to undertake the training of men for special purposes. At present we are training a man specially for botanical work under the Department of Agriculture, Burma, and we have had a student from the Goribidnur Sugar Refinery, South India, for training in sugar analysis.

University and other Examinations.

9. At the University Agricultural Examinations held in 1912, the number of candidates shown in the following list were presented, with results as indicated:—

	Sent up.	Passed.	Failed.	Percentage of passes.
First Examination in Agriculture	31	22	9	70·9
Second Examination in Agriculture	18	16	2	88·8
Bachelor of Agriculture Examination	27	22	5	81·5

The results are fairly satisfactory except in the first year's examination. The large percentage of failures in this year were chiefly due to failure in Mathematics on the one hand and in practical agriculture on the other.

A special College Examination of the students (referred to above) not entitled to take the University Examination, was held in February and March 1912 with the following results:—

	Presented.	Passed.	Failed.
First Examination in Agriculture	3	3	...
Second Examination in Agriculture	5	4	1
Final Examination for Diploma in Agriculture	1	1	...

Scholarships.

10. The number of scholarships offered by Government at this college is now fifteen per annum. Candidates must have passed the Previous Examination of the Bombay University, and are selected by the Director of Agriculture in consultation with the Principal of the College. They are given by preference to the sons of cultivators and are awarded for three years occupied by the course. The Director of Agriculture is empowered to extend the tenure of the scholarships to four years, and give a limited number to Matriculates, who afterwards will join this college, for study in an Arts College. During the last five years those for students actually coming to this College have been awarded to candidates from the various districts as follows :—

	1908.	1909.	1910.	1911.	1912.
Deccan	2	...	2	5	6
Southern Marátha Country	2	3	3	3	2
Gujarát	2	2	3	6	...
Konkan	2	1	2	1	...

11. The students from Sind are on a different basis. They are appointed by the Commissioner in Sind, and are not required to have passed the Previous Examination in every case. We have now at the College two such scholars from Sind in the first year, two in the second year, and one in the third year.

12. Other Governments and the public bodies have utilised the College for the training of scholars. The number so admitted since 1908 has been as follows :—

Date of Entry

	1908.	1909.	1910.	1911.	1912.
Government of Eastern Bengal and Assam.	1	2	...	...	...
Government of Bengal	1	...	...	...	...
His Highness the Nizam's Government. ...	2	...	...	...	...
Baroda Government	...	2	...	...	2
Sángli State	...	...	1	...	...
Jamkhindi State	...	...	...	...	1
Porbandar State	...	...	...	1	...
Kotah State	...	...	...	1	...
Vithalgadh State	...	...	...	1	...
Jámnagar State	...	...	...	1	...
Lingáyat Education Fund	1	3	1	...	...
Infanticide Fund, Northern Division ..	1	...	...	...	...
Ceylon Government	...	...	...	...	4
Bansda State	...	...	...	...	1

13. During the year a valuable new endowment has been completed by an old friend of the College, Mr. Gulabdas Bhaidas Vakil of Surat, who has given Rs. 2,500, the interest of which is to be used as a scholarship in commemoration of the Coronation of His Majesty King George V. The scholarship is to be given to the student who stands first in the second examination in agriculture of the University of Bombay. The thanks of all connected with the College are due to Mr. Gulabdas Bhaidas who has thus, for the second time, showed his practical sympathy with higher agricultural education.

Library.

14. The growth of the College library is very satisfactory. Five years ago it did not exist. On the separation from the College of Science being completed, a number of books (chiefly old and out of date) on Agriculture, Botany and Veterinary Science were handed over to us and formed a nucleus for the future. A special grant of Rs. 6,000 per annum was made in 1909 for library purposes, and has been continued during the two following years. With the funds thus made available and a number of presentations of books, the library has rapidly increased. The number of books in it at the end of the last four years has been as follows :—

1908-09	1,182
1909-10	2,780
1910-11	4,000
1911-12	5,040

It is fairly consulted, not only by College students, but by gentlemen from all parts of the Presidency, and every effort is made to make it increasingly useful to the public.

College Quarters.

15. Some progress with regard to the building of college quarters has been made during the past year. The design for the new buildings had been previously sanctioned, and the foundations put in and the building completed to the plinth level before the commencement of the year. The building has been proceeded with and it is hoped that this building may be completed before June 1913. In the meantime the objectionable arrangement continues by which our students are scattered over five different places in small buildings and bungalows taken for them.

Employment of Graduates.

16. The question of the employment of agricultural graduates becomes a more serious one every year. Naturally it is to be hoped that a continually increasing number of students will leave the College with the intention of managing their own lands. There is every sign of this being the case. At least thirteen or fourteen men (including the short course students) who have left the College in the present year intend to make use of their knowledge on their own land. But there remains, and must always remain in Bombay a very large proportion of graduates who will be on the look-out for other openings.

In the present year the following appointments have been made from the Bombay graduates of the Agricultural College :—

Bombay Agricultural Department	...	8
Bombay Revenue Service	...	4
Baroda State	...	1
Other Native States	...	1
Municipal and Private Bodies	...	1

Veterinary Dispensary.

17. The District Veterinary Dispensary at Bhamburda has been carried on as a College Dispensary during the year. During this time 245 in-patients and 502 out-patients were treated or a total of 747. Of these 300 were agricultural animals. The daily average attendance of in-patients was 10·7 and of out-patients 6·5. Out of 747 cases, 331 were treated free. Among contagious diseases, there were seven cases of rabies in dogs, while one pony belonging to a cultivator of Hingne village died of Surra in the isolation ward, one dog died of tetanus, two bulls were treated for red-water, and several bovines for foot and mouth disease. Visits were occasionally paid by the veterinary officers to the Civil Dairy, Kirkee, and the Agricultural College Farm. The neighbouring villages within a radius of 5 five miles of the hospital were visited with the object of inducing the ryots to avail themselves of the free treatment allowed for their animals. In some cases treatment was also given at their homes. During an out-break of rinderpest in the Military Dairy, Kirkee, the officer in charge assisted in inoculating over 800 animals with rinderpest serum. Several post-mortem examinations on cattle, horses, dogs, and fowls were held that either died here or were brought for that purpose.

Other Matters.

18. During the year under report the college undertook the responsibility, for the second time, of giving the short three weeks' course in agriculture which all the junior members of the Indian and Provincial Civil Service have to take. It was attended by seven members during the present year, and the teaching was undertaken by Professors Knight and Burns, and myself.

19. The staff on the whole have worked well, and are doing a considerable amount of research, and also of demonstration work in addition to their own duties. The College tends to become every year more and more of a centre for activity in connection with agricultural improvement and the dissemination of agricultural information. It has hence been visited by a constantly increasing number of landlords and other interested gentlemen on the one hand and on the other by large crowds of cultivators. Every effort is made to stimulate this public interest, as it is felt that the permanent success of the institution must largely depend on the extent to which it can be maintained.

I have the honour to be,
Sir,
Your most obedient servant,
HAROLD H. MANN.
Principal.

APPENDIX B.

ACCOUNT OF THE VERNACULAR AGRICULTURAL SCHOOL, POONA, FOR 1911-12.

The Vernacular Agricultural School has been established as an experiment, the object of which was to give a thoroughly practical agricultural training to boys who belonged to good substantial village families; and whose object in life was to cultivate and manage their own land. With this conception in view it was opened in Poona in June 1910, with a course of two years for boys by preference between the ages of 13 and 16 who had passed the fourth Maráthi Standard at least. It was placed under the control of the Principal of the Agricultural College, but was quite independent of the College, with an agricultural graduate as head master, though a part of the college farm was used for the practical training of the boys.

With a scheme of which these are the general outlines, the school has now been carried on for over two years. A year ago a survey was made of its work and an estimate of its probable success and practical utility. The additional year's experience has tended on the whole to justify the estimate then made.

In the first two years thirty-five boys joined the school derived from the various Maráthi-speaking districts as follows :—

	1st year.	2nd year.
Poona	5 boys	...
Sátára	2 boys	1 boy.
Sholápur	1 boy	1 boy.
Ahmednagar	2 boys	4 boys.
Násik	7 boys	3 boys.
Khándesh	1 boy	1 boy.
Ratnágiri	1 boy	1 boy.
Kolhápur State	1 boy	1 boy.
Nizam's Dominions	1 boy	...
Miraj State	...	1 boy.
Sángli State	...	1 boy.

Arranged according to caste, the boys stand as follows :—

	1st year.	2nd year.
Márathas	9 boys	8 boys.
Mali	1 boy	...
Bráhmins	8 boys	6 boys.
Others	3 boys	...

The head-master has been, as in the previous year, Mr. K. M. Powar, B.Ag., and he has put great enthusiasm and energy into the work. Such success as the school has attained is largely due to him. In the first year he has been assisted by Mr. R. Y. Hulkoti, B.Ag., who has been placed at the school for training, with a view to becoming head master of the proposed Kánarese School at Devi Hosur in the Dhárwár District. He has taken to the work with enthusiasm also and promises to make a very successful head-master when the school is established in 1913.

The school has been supported by a number of local boards during the two years, and subsidies have been received as follows :—

	1910-11.	1911-12.
	Rs.	Rs. a. p.
East Khándesh	200	200 0 0
Poona	225	...
Násik	250	250 0 0
Ratnágiri	60	...
Sátára	...	116 2 1
Sholápur	...	50 0 0
Ahmednagar	...	100 0 0

The curriculum which was very much of an experiment at starting, on the whole has proved with modification in detail a considerable success. It involves, as was explained a year ago, at least half the working time being spent in form work, or in gardening, in dairying or in other agricultural operation. The boys do practically all the work in the land allotted to their use, and they have almost entirely produced the food, except the grain and pulse used in the school. The school work, more properly so-called, consists

of arithmetic, more especially including farm accounts on the one hand, and mensuration applied to agricultural purposes on the other, nature study largely taught practically; writing and reading; geography of India, especially in relation to crops; the principles of agriculture, and two new subjects—(1) village life, including sanitation, hygiene, and secondary occupations suitable for villages; and (2) what we call 'citizenship', which includes questions of how to obtain money by takavi, by co-operative credit, etc., and in addition, the system of local and village Government in this part of India.

As already indicated the number of boys who joined in the second year was not so great as the first, owing largely to less advertising of it. The idea of sending village boys away for such training is new, and there is considerable hesitation on the part of village patils and the like to do so. This has to be got over by a good deal of encouragement. The number, as I shall show, is higher again in the third year. There is always too considerable leakage at first, and always will be, I suppose. The school has been visited frequently by a number of the senior men belonging to the Agricultural Department including Mr. P. C. Pátil, L.Ag., Divisional Inspector of Agriculture, Rao Saheb G. K. Kelker, Assistant Professor of Agriculture in the Poona Agricultural College, and Messrs. V. G. Gokhale, L.Ag., and C. V. Sane, B.Ag., the Superintendents of the College Farm.

The School year was divided into two terms, the first of which closed in October, and the second in April. At the end of each an examination was held, and the following is an extract from the report of Messrs. V. G. Gokhale and C. V. Sane on the results of that held in April 1912:—

"The results as a whole show that the students have read up their courses well and put their hearts into the practical work.

"Both the classes have done well in the principles of agriculture, arithmetic, village life, and sanitation, and in Maráthi, but are rather poor in nature study and geography.

"We wish praticularly to note here that the answers of the second year agricultural papers were very well informed, to the point, interesting, and testified to a good grasp of the principles taught.

"As regards handling of implements, and management of cattle, they are naturally quite up to the mark."

Fifteen certificates of completing the course were granted to second year boys, and one has been allowed to stay for a third year. We are keeping in touch with the parents of the boys who have gone back to their villages, and hope by this means to find out how the course has benefitted the boys, and also its weakness, so that where necessary modifications can be made. All the first year boys were allowed to proceed to the second year.

The accounts of the school are shown in the following statement. The sale-proceeds of farm produce will appear small, but it must be remembered that practically the whole of the produce obtained was consumed by the school boys and by the stock kept.

Receipts.

		Rs.	a.	p.
1.	Balance from 1910-11 ...	60	0	2
2.	Poona Treasury (Government grant) ...	7,500	0	0
3.	Local Board grants ...	716	2	1
4.	Sale-proceeds of produce ...	99	5	9
		8,375	8	0

Expenses.

		Rs.	a.	p.
1.	Establishment	1,703	0	0
2.	Boarding charges ...	1,984	4	11
3.	Purchase of live stock ...	330	9	0
4.	Cultivation charges, making sheds, etc.	705	13	10
5.	Feeding of stock	1,006	14	7
6.	Rent of school and sweeper charges	1,609	1	0
7.	School furniture and books ...	176	6	6
8.	Oil	49	2	3
9.	Stationery and Postage ...	87	13	6
10.	Terms of observation ...	34	1	6
11.	Travelling allowances to teachers	138	15	0
12.	Sale-proceeds of produce, as *per contra* (sent to Poona Treasury)	99	5	9
13.	Balance in hand	450	0	2
		8,375	8	0

The third year of the school commenced on June 10th, 1912, in the same building (Kirkee Lodge) which was used during the second year. A large number of applications for admission were received, but these were rigorously weeded out, and twenty-nine boys were admitted, coming from districts as follows :—

Poona	5
Sátára	4
Sholápur	4
Ahmednagar	4
Násik	2
West Khándesh	1
Belgaum	1
Bijápur	1
Colába	1
Thána	1
Baroda State...	1
Mysore (lands in Sátára)...	1
Janjira	1
Sávantwadi	1
Sángli	1

The caste of these boys was as follows :—

Bráhmins	17
Márathas	10
Others	2

During the year a step has been taken which has been in contemplation ever since the school was established, namely the obtaining of land in a rural area to which it should be transferred as soon as the necessary buildings are provided. An area of twenty-nine acres of disforested land has been selected near Loni Kalbhor, about ten miles to the south-east of Poona and about half a mile from Loni station. The land is good, capable of irrigation where this is required, and appears eminently suitable for the purpose of the school. Before another year is past, I hope the school will be transferred there.

The school is in my opinion now a decided success. It is appreciated by the parents of the boys, some of whom frequently visit it; it has attracted largely the class of boys for whom it was designed; and has led the way to the more general establishment of a type of school which cannot but be of great advantage to the agriculture of the country.

HAROLD H. MANN,
Principal.

APPENDIX C.

SUMMARY OF THE WORK DONE UNDER THE DEPUTY DIRECTOR OF AGRICULTURE, BOMBAY PRESIDENCY, IN 1911-1912.

COTTON.

GUJARA'T.

An important scheme for the organization of a market for improved strains of Broach cotton, grown by cultivators in the Surat District, was initiated in the year under report. As a result of a conference with the Bombay Chamber of Commerce, four of the leading members of the Cotton Trade formed a Syndicate to perform the following functions on condition that the total quantity supplied should not fall short of the equivalent of 2,000 bales (400 lbs.) :—

(1) To provide a buying agency on the spot.

(2) To purchase the seed-cotton certified by this Department at an excess rate amounting to 5 per cent. above current market rates for ordinary Deshi cotton.

(3) To gin the seed-cotton separately from all other lots and return the seed to the Agricultural Department for redistribution.

The Department accordingly distributed over 60 tons of seed and provided a large reserve to meet the contingency of second sowings being necessary if the season proved adverse and it was estimated that an area of 11,450* acres was sown with this seed. Unfortunately, owing to a combination of unfavourable conditions, such as drought and the absence of dew at the time the bolls were bursting the total crop of seed-cotton produced was equivalent to only 1,167 bales, but the Syndicate did not raise any objection.

As is natural in the first season's working of a new scheme, involving several departures from local customs, a number of hitches arose, which may be briefly summarised as follows :—

(1) The cultivators being doubtful whether our cotton would yield as well as Deshi, were not, in all cases, desirous of buying our seed.

(2) The local petty traders became alarmed that their business was being taken away and, by spreading false reports, put many prejudices into the minds of cultivators against accepting our seed.

(3) The cultivators complained of the long distance they had to cart the seed-cotton to the Syndicate's gins at Ránder and Bárdoli.

(4) The prices at first quoted at the buying agency were not really 5 per cent. above market rates, a point which the Syndicate took steps to rectify.

(5) In the early part of the season, cultivators could not get advances from the Syndicate's agent at Ránder.

(6) Competition for the produce by local dealers who, in order not to lose seed-cotton, offered higher prices.

(7) Some cultivators brought in inferior seed-cotton.

(8) The usual facilities given to cultivators at the gins, *e. g.*, arrangements for food and lodging were not provided by the Syndicate at Ránder.

(9) There was some difficulty in getting the ginneries satisfactorily cleaned and all extraneous seed removed before the seed-cotton was ginned.

Eventually all these difficulties were surmounted and the scheme, as a whole, worked very well. The Syndicate appeared to be well satisfied with the cotton, though, owing to fluctuations in the world's market, which caused a disturbance in the relative prices of American and East Indian cottons, they say they incurred a small loss.

Although the improvement claimed for these cottons over Deshi is their superior quality of fibre, nevertheless they have given very satisfactory ginning outturns, as may be judged, from the following comparative statement, a fact which must have been appreciated by the Syndicate :—

Name of variety of cotton.	Number of maunds† of seed-cotton required to yield one-800 lbs. khandy (really 798 lbs.) o cotton.		Ginning percentage equivalents.	
	Ránder gin.	Bárdoli gin.	Ránder gin.	Bárdoli gin.
Deshi	65½‡	67·75	32‡	31
Improved cottons	64	65	32·8	32·8

* And in addition some 1,200 acres in adjoining villages in Baroda Territory were likewise cropped with this cotton.

† One maund = 38 lbs. and one khandy = 21 maunds.

‡ These figures were obtained from Native local merchants and should be taken with caution.

The average rates* paid for the seed-cotton were—

Ránder gin Rs. 131-14-7 per bhar of 924 lbs.

Bárdoli gin Rs. 132-0-0 do.

and the cultivators were well satisfied with the promptitude with which payments were made as well as with the accuracy of the weighments at the ginneries.

It has been arranged with the Syndicate to extend operation in 1912-1913 when it is hoped that 15,000 acres will be sown with seed supplied by this Department. This will be sown in four groups of villages in each of which the Syndicate will provide a ginnery and thus one of the chief difficulties with cultivators—*viz.* long lead—will be easily done away with.

Southern Mara'tha Country.

Western parts of Dhárwár District.—The Department again organized an auction-sale at Dhárwár for the disposal of Navsári (Broach) cotton grown in the west of the Dhárwár District and a supplementary auction was held on the same day at Garag, a village 10 miles from Dhárwár, where much of this cotton had been grown†.

The Department had distributed upwards of 30,000 lbs. of seed, while local merchants had distributed another 10,000 lbs. and hence a crop of about 1,000 Nagas (1,344 lbs. of seed-cotton) was expected. This yield was not nearly realized owing to the very unfavourable season. The following statement summarizes the classes into which the Department graded the cotton, and prices obtained therefor with the names of the purchasing firms:—

Grades.	At Dhárwár auction-sale.				At Garag auction-sale.			Name of purchaser.	
	Ginning per-centage.	Quantity of Kapas in each grade.	Rate per Naga.	Value of Kapas in each grade.	Quantity of Kapas in each grade.	Rate per Naga.	Value of Kapas in each grade.	Dhárwár.	Garag.
		N. m. lbs.	Rs.	Rs. a. p.	N. m. lbs.	Rs.	Rs. a. p.		
Special ...	34 and above.	14 35 5	203	2,900 12 4	.....	...	.....	Agent of Messrs. Ahmedbhai Habibbhai of Bombay.	.....
... ...	33-34	23 10 27	201	4,677 4 7	9 5 20	203	1,853 1 2	Agent of Messrs. Tata and Sons of Bombay.	Messrs. Ahmedbhai Habibbhai of Bombay.
II	32-33	51 33 0	190	9,740 6 8	52 31 17	192	10,110 6 10	Agent of Messrs. Madhavlal Ranchodlal of Ahmedabad.	
III	31-32	38 33 25	182	7,044 8 2	86 21 24	191	16,512 15 8	Agent of Messrs. Ahmedbhai Habibbhai of Bombay.	
IV	30-31	29 8 22	175	5,107 0 6	73 5 0	183	13,378 0	Do. ...	
V and VI ...	29-30 and below 29.	6 32 25	170	1,133 7 11	26 39 15	177	4,747 12 0	Agent of Messrs. Tata and Sons, Bombay.	
Unclassed ...	...	7 30 23	169	1,479 12 9	11 13 26	194	1,290 4 8	Agent of Messrs. Madhavlal Ranchodlal of Ahmedabad.	
Kumpta Cross ...	29 and below.	7 2 19	162	1,143 0 7	.....	...	.....	.....	.....

Note.—One Naga of seed-cotton = 1,344 lbs.

It is a matter of great importance to add here that the difficulties, which were formally considerable in organizing an auction sale, have, for practical purposes, been surmounted, owing to the advantages having become realized both by the trade and the cultivators, from whom inquiries as to the date of the auction are now regularly received. Cultivators are keen to sell their cotton at the auction-sale while buyers attend the same in force and the nature of the bidding is assuming the appearance of a live-stock auction-sale in England. These auctions were run on commercial lines and thus a net profit of Rs. 397-1-8 was realized or ample to compensate for the Departmental supervision which was not charged for. It will thus be seen that the time appears opportune for devolving the organization of these auctions on to some local body, such as the Dhárwár Agricultural Association, and an effort will be made to give effect to this object next year.

It has not been found possible yet to make an accurate survey of the exact area suitable for Navsári cotton, but we know that the conditions are favourable in the following tálukas:—Dhárwár, Hubli and Bankápur (Dhárwár District), Sampgaon (Belgaum District) in which the cotton area amounts to over 140,000 acres and it seems reasonable to assume that the area suitable for this cotton in these tálukas and also to some extent in other tálukas will not prove to be less than 50,000 acres.

Now in order to form an idea of the financial gains to be made by substituting Navsári cotton for Kumpta on this area, it is necessary to refer to the advantages of the former over the latter. These may be summarized briefly as follows:—

(1) It posses a higher ginning percentage: thus 100 lbs. of Navsári seed-cotton gives 33 lbs. of lint, while an equal quantity of Kumpta seed-cotton gives 27 lbs. of lint.

* Inclusive of the excess of 5 per cent.

† Out of a total cotton area of 500 acres in this village, 450 acres were cropped with Navsári cotton.

(2) The yield per acre is higher in the proportion of, roughly, 11 to 10.

(3) The wastage in spinning is less in the proportion of, roughly, 11 to 16.

(4) The colour is brighter and the staple slightly superior, and

(5) The seed-cotton can be picked cleaner from the bolls with less leaf dust.

For these reasons and also on account of the prices obtained at the auction-sales it seems fair to value* Kumpta seed-cotton at Rs. 120 and Navsári at Rs. 170 per Naga (1,344 lbs.). Now under favourable conditions, Kumpta may be expected to yield 550 lbs. per acre (*vide* item 2 above). With these data, it may be shown that the increased gross profit per acre from Navsári over Kumpta cotton amounts to—

Rs. 25-2-0 ... { Rs. 18-12-0 on account of higher price,
Rs. 6-6-0 on account of heavier yield.

But there is some evidence in support of the opinion that Navsári cotton is a more exhausting crop than Kumpta and hence we may allow for a reduction of 100 lbs. of grain and a corresponding amount of fodder—worth, say, Rs. 5 per acre. Further, the cost of production amounts to Rs. 3 per acre more in the case of Navsári cotton and hence after making these deductions we see that the net profit to be derived from an acre of Navsári cotton exceeds that of an acre of Kumpta cotton by some Rs. 17, which, over an area of 50,000 acres, would amount to 8½ lacs of rupees. The great obstacle which stands in the way of this result being realized is the uncertainty of the rains. Navsári cotton must be sown early, *i. e.*, not later than July and hence if sowing rains are not received in time it is better to sow Kumpta cotton in August. This can be done without much actual loss to the cultivator only some four annas per acre (representing the difference in value of Navsári seed for sowing and feeding purposes respectively), but the effect on the market is likely to be more disadvantageous as the trade prefer to deal in commodities which are regularly available.

South-Eastern parts of Dhárwár District.—This is the tract where saw-ginned Dhárwár-American cotton, introduced nearly a century ago, is grown, and the area annually cropped with this variety has been roughly estimated at 200,000 acres. Experiments at Gadag have shown the great superiority of Cambodia (102 E) cotton over the local variety, the advantages of which may be summarised as under:—

(1) A higher ginning percentage of at least 7 per cent. The ginning percentage of saw-ginned Dhárwár is normally about 30 per cent., while a very moderate sample of (102 E) Cambodia gins at 37 per cent. and good samples at 1 to 2 points higher. The highest ginning percentage attained by this cotton on the Gadag Farm was 42·8 in 1909-1910.

(2) A higher yield in the proportion of at least 9 to 8.

(3) The seed-cotton being produced in large well-opening bolls can be picked cleaner.

(4) The colour of the cotton is brighter and the staple more uniform.

(5) The cotton is "bulkier".

(6) It is markedly resistant to "red leaf blight" which so severely attacks saw-ginned Dhárwár.

This cotton has been tested against local Dhárwár-American cotton for some years on the Gadag Farm. The results obtained for the last two years were as under:—

Season.	Area of plot in acres.	Yield per acre of seed-cotton in lbs.		Ginning percentage.		Remarks.
		Cambodia.	Saw-ginned Dhárwár.	Cambodia.	Saw-ginned Dhárwár.	
1910-1911	·375	410·5	221	38·30	30·70	A poor season.
1911-1912	1·8 and 0·9 respectively.	197	101	38·05	28·30	A very bad season.

Attention is invited to the relative yields obtained in the year under report in conjunction with the following remarks upon the monsoon. The total rainfall upto the end of August was 10·13 inches. During September three-fourths of an inch fell which was insufficient to permit of sowing operations at the normal time and these had to be delayed for nearly

* These rates are much lower than those actually obtained at the auction-sales, but at that time (7th April 1912) quotations were ruling high.

a month until after the 10th of October, when there was a fall of a couple of inches within a few days.

After the crop was sown, there were only 25 cents of rain until the 1st December, when an unexpected shower, amounting to half an inch, occurred. Thus the total rainfall for the whole season fell below 14 inches.

Nevertheless, Cambodia yielded a much heavy crop than saw-ginned Dhárwár and established its claims to be regarded as a drought resistant variety of exceptional capacity. Over 5,000 lbs. of Cambodia seed was distributed among cultivators and in order to secure a good market for their produce as well as to meet the wishes of the trade, the Department held an auction-sale on the 14th of April, with the excellent results tabulated below :—

Grade.	Total number of Dokras 6½ to 8 maunds of 28 lbs. each.	Total weight of seed-cotton.			Ginning per-centage.	Total weight of cotton per Naga (1,344 lbs.) seed-cotton.	Price per Naga in rupees.	Name of purchaser.
		Nagas (1,344 lbs.).	Maund (28 lbs.).	Lbs.				
I ...	37	8	36	18½	35-36	477	206	Representative of Sir Chinubhai Madhavlal of Ahmedabad.
II ...	96	22	47	14	34-35	463	200	Representative of Messrs. Tata and Sons, Bombay.
III ...	20	5	12	18	33-34	450	203	Mr. Ligangauda Patil of Hulkoti (Gadag).
IV ...	31	8 Cotton.	...	17½	32-33	437	188	Mr. Manik Pitamber of Hubli.
V ...	91	49	1	1	...	...	120	Messrs. Tata and Sons, Bombay.

Note 1.—Messrs. Padumji, Cotton Merchants, Gadag, gave the local quotations for saw-ginned Dhárwár on the day of the auction as follows :—

Seed-cotton Rs. 140 per Naga (1,344 lbs.).

Cotton Rs. 108 per Naga (326 lbs.).

Note 2.—The Department graded all the seed-cotton according to ginning percentage, preparatory to the auction and the results were communicated to the public.

Note 3.—It will be noticed that grade III sold for a higher price than grade II which was due to the keen demand for this cotton.

Messrs. Tata and Sons, who had also purchased this cotton in Madras, where the area under Cambodia has enormously expanded in the last few years, conducted a comparative spinning trial of samples received from Gadag and Madras. These tests are summarized in the following statement :—

Results of trials taken to spin 20 s (count) from Cambodia cotton purchased at different places.

Item.	Source of production.	
	Gadag.	Madras District.
Tension	Lbs. 57·85	Lbs. 57·28
Turns per inch of spinning wheel	„ 19·64	„ 19·64
Blow-room loss	7·5 per cent.	9·87 per cent.
Price per Boja of 345 lbs.	Rs. 141	Rs. 134-6-0
Net price per pound	As. 7-0·03	As. 6-10·16

In commenting upon these trials, Messrs. Tata and Sons point out that while Cambodia, grown at Gadag, showed only 7·5 per cent. of blow-room loss, the consignment purchased in Madras gave a loss of 9·87 per cent., and further that the staple of both lots was equally long and strong, but that the Gadag sample appeared to be slightly more "neppy"* than

* "Neppy" refers to the presence of small quantities of fibre matter together into knot-like masses.

the Madras one, which might be due to the different methods of ginning employed. The fact that the length of the staple is equal to that of Cambodia, grown in Madras, is of great interest as the conditions under which this cotton is cultivated in that Presidency, *viz.*, light soils and irrigation from wells naturally lend themselves to the production of good staple, whereas at Gadag cotton has to be grown as a rabi* crop (*i. e.* receives no rain during the growing period) on medium black soil and without irrigation. Another very important point is the fact that the fibre is found to be strong, because in a season of drought like the one under report, it has been noticed that the fibre of newly introduced cottons has a tendency to become brittle.

In order to demonstrate what the results of these experiments with Cambodia cotton mean to the prosperity of the district it is necessary to give a few figures. For this purpose I propose to take the very moderate yield (for average soil in a normal season) of 275 lbs. of seed-cotton per acre for saw-ginned Dhárwár-American and a market rate of Rs. 120† per Naga (1,344 lbs.) of seed-cotton. At these rates the gross value of the crop per acre works out at Rs. 24-9-0 and if we take Rs. 14 as the cost of production per acre the net profit per acre amounts to Rs. 10-9-0.

Under the same conditions the yield of Cambodia may be taken at 310 lbs. per acre, *vide* item (2) above, worth, say, Rs 175* per Naga and thus the gross value of the crop per acre would work out at Rs. 35-13-0. Now the cost of production is the same as for saw-ginned Dhárwár and hence the net profit per acre would be Rs. 26-3-0 or a gain of Rs. 15-13-0 (say Rs. 16 per acre). Now it is probable that the whole of the 200,000 acres under saw-ginned Dhárwár is suitable for Cambodia cotton, but if only half of it were so, even then the annual increased wealth of the district would amount to some Rs. 16 lacs.

KHA'NDESH.

In Khándesh the cotton universally grown consists of a mixture of some half a dozen types of very varying agricultural value. For the last three years samples of seed have been collected from each táluka and sown on one of the Government Farms, where the offspring could be carefully examined. As a result of this detailed analytical work it has been found that the average composition of Khándesh cotton consists of the mixture noted in the statement below, in which is also summarised details concerning the ginning percentage, the yielding capacity, and the outturns which may reasonably be expected under normal conditions, together with the values of the same.

Names of constituents in Khándesh mixture.	Average percentage of each constituent in Khándesh mixture.	Average ginning percentage during the seasons 1909-10 and 1910-11 on Dhulia Farm.	Average of actual yields obtained in two seasons 1909-10 and 1910-11 on Dhulia Farm.	Relative yields per acre taking a lower standard to suit all classes of soil.	Gross value of crop (yiel being as shown in column 5) per acre.	Increased value of crop per acre takin Khándesh mixture as the standard.
1	2	3	4	5	6	7
					Rs. a.	Rs. a. p.
Roseum (N. R.)	46·60	37·5	946·0	310	36 14 0	6 6 0
Roseum Cutchica (N. R. C.).	27·60	36·0	861·5	.....	.....	.....
Jari types ... {N. V. ... N. V. M.. N. V. K..}	25·80	27·0	620·5	.....	.....	.....
The mixture its f ...	100·00	34·4	838·7	275	30 8 0	.....

1.—Calculated figures in the case of mixture itself.

2.—These two seasons were much above the normal.

3.—The price taken for seed-cotton of Khándesh mixture is Rs. 16 per 144 lbs. and that for Roseum is Rs. 17-2-0, calculated in proportion to its higher ginning percentage.

It will be observed that the net gain to be made by growing pure Roseum instead of Khándesh mixture is estimated at Rs. 6-6-0 per acre and is brought about jointly by the naturally more prolific character of the variety (estimated at 35 lbs. of seed-cotton per acre) and by the higher ginning percentage of the seed-cotton (found to be 3·1, *vide*

* The cotton crop is sown about the middle of September at Gadag and there is seldom more than an inch or two of rain afterwards.

† These rates are considerably less than those actually realized at the auction-sale but at that time (14th April 1912) quotations were ruling high.

statement above). If however it is desired to be absolutely on the safe side we may take the following figures :—

Superiority in yield 20 lbs.

Superiority in ginning percentage 2 per cent.

In which case we find that the value of the improvement amounts to Rs. 3-9-0 per acre. Now there are 1,300,000 acres annually put under cotton in Khándesh (both districts) and hence if the whole of this area were sown with pure Roseum cotton instead of Khándesh mixture then the additional wealth to these districts would amount to Rs. 50·7 lacs or say half a crore annually.

This is no new cotton but an indigenous variety admirably adapted to the conditions obtaining in Khándesh and equally fulfilling the requirements of the export trade which demands a bright white fibre and cares little for staple. Under these circumstances, the Department has merely to organize a scheme for the production and distribution of seed and it would obviously be fully justified in devoting a great deal of time and money upon such a work. The first thing, which should be done, is the establishment of a large seed farm to be entirely under Government control and, subsequently, there should be organised a large number of secondary seed farms to be run by private enterprise, subject to a certain amount of Government supervision.

Other Districts.

Although the localities referred to above represent the most important cotton tracts, nevertheless the combined cotton area in other districts amounts to nearly as large an acreage. The most important districts in which work upon cotton has still to be commenced are :—

Name of district.	Cotton area in acres.
Bijápur	550,026
Ahmedabad	307,047
Broach	233,587
Belgaum	225,466

and it is quite probable that improvements, commensurate with those described above, are awaiting exploitation by the Agricultural Department.

The little tentative work that has been done in Bijápur and Broach Districts certainly indicates that the cotton grown in these districts can be greatly improved. It is further probable that with the extension of irrigation in the Deccan there will be a corresponding expansion in the area under cotton. Experiments with Cambodia cotton, conducted at the Government Farm on the Gokák Canal, have demonstrated that heavy yields of good quality can be obtained. Similarly excellent results have been obtained on the Nadiád Farm with the aid of slight irrigation, and it seems quite probable that it would pay to replace a part of the tobacco area with Cambodia cotton in the Charotar tract.

Experimental work.—It is unnecessary to add much to the remarks made in last year's report more than to say that these operations have been continued on the same lines, but were interfered with by the abnormal drought which characterized the season.

Cereals.

Experimental work has been continued on the same lines as described in last year's report and there is nothing of special interest to add here though full details are given in the several farm annual reports.

Oil-Seeds.

Groundnuts.—Experimental work on this crop, more particularly on varieties, has been narrowed down, as fairly conclusive results have been arrived at.

For cultivation as a rain's crop without supplementary irrigation there are only two suitable varieties. Spanish peanut is probably the best, though trials with Japanese small were partially vitiated owing to the new seed being spoiled in transit.

At Dhárwár on black soil, where the rains are better distributed, Senegal and Mozambique can, with advantage, be grown as dry crops in preference to the two varieties just mentioned.

As regards irrigated varieties there is very little to choose between several, but probably large Japanese is as good as any, though Virginia is also a good yielder.

Remarkable results were obtained with Spanish peanuts on the Dohad Farm in the Panch Mahals. The total rainfall was only 8½ inches, yet this crop gave an outturn of 2,070 lbs. of nuts (dry) and left a net profit of Rs. 127-5-6 per acre in a famine year when

other crops largely failed from drought or were completely wiped out by hairy caterpillars, which pest apparently avoids groundnuts.

As showing the adaptability of this crop a yield of 1,300 lbs. of nuts per acre was obtained at Sanjan in Thána District which had a rainfall of 39·37 inches, while good results were obtained in Ratnágiri where the rainfall amounted to 73·42 inches.

Considerable progress has been made in the introduction of this crop into localities where hitherto it has not been cultivated, more particularly in the south Konkan (including Kánara) and Khándesh. In the year under report over 7,000 lbs. of seed was distributed in the Konkan, while the demand for seed in the current season (1912-13) amounted to 13,000 lbs. The crop is grown there for oil-crushing as well as for consumption. Excellent results have been obtained with Nágli on the poor warkas soils of the Konkan by taking a crop of groundnuts in the previous year. In Khándesh 7,590 lbs. of seed were distributed but, unfortunately, owing to the abnormally bad season, little in the way of results was obtained.

Selection work was continued on Groundnuts Til, Castors and other oil-seeds, but, for reasons explained above, was much interfered with.

Tobacco

The experiments with new American varieties of tobacco, suitable for cigarette purposes, indicate that white Burley is the most promising. In the field this variety particularly caught the eye with its uniform growth, thin leaf and bright colouring when mature. On the strength of this year's results, it has been decided to give this variety and also Ayasolonk (Turkish variety) a trial on a large scale of one acre each, in order to ascertain reliable information with regard to yield and curing properties.

The experiments with Potash manures, with the object of raising the Potash content of the leaf, which is so deficient in Nadiád tobacco, has not produced positive results yet.

Manurial Experiments.

As might have been expected, concentrated and highly forcing manures did considerably more harm than good in the year under report on dry crop land. This is well illustrated by a few results tabulated below. The fourth and sixth column figures may be taken as indicators of what the relative yields would have been, had the rains proved favourable.

Name of farm.	Manurial treatment.	Cotton yield per acre in lbs.		Jowar yield per acre in lbs.	
		Chief product.	By-product.	Chief product.	By-product.
1	2	3	4	5	6
		Lbs. oz.	Lbs.	Lbs. oz.	Lbs. oz.
Surat ...	Poudrette ...	9 1	1,545	260 0	3,977 5
	Nil	31 4	695	282 8	1,915 0
Dhárwár ...	Complete artificial manure.	300 0	790	350 0	1,940 0
	Nil	298 0	630	550 0	940 0

Note.—In both cases the manure was applied to cotton, and jowar was grown on the residue of the previous year's treatment.

It will be noted that in the case of Surat the adverse effect of the poudrette residue did not prove so disastrous, because a good yield of kirbi was obtained considerably higher in fact than that obtained last year, when the season was a good one. This was particularly useful in the year under report when fodder prices exceeded the normal by 200 to 250 per cent. owing to the famine in Northern Gujarát, and owing to these very high rates the value of the produce from the poudrette plots exceeded that of the next best plots (manured with town sweepings) by 25 per cent. and left a net profit of Rs. 22-3-10 per acre. As a set-off against these disastrous effects of poudrette upon the cotton crop the extremely good results obtained at Surat with night-soil applied to the land in April 1911 are of great interest. The crop in this case resisted the drought to a very great extent, retaining its green appearance much longer than that on other plots and yielded an outturn of 477 lbs. of seed-cotton per acre, while the jowar yields of 2,554 lbs. of grain and 15,755 lbs. of kirbi per acre were quite phenomenal; these yields are about 300 per cent. above normal.

On irrigated land at Gokák, excellent results have been obtained with poudrette upon the maize crop during the past two seasons as may be gathered from the following statement:—

Name of manure.	Yield per acre in lbs.				Average value of produce per acre in rupees.	Average cost of production per acre in rupees.	Average profit per acre in rupees.
	1910-11.		1911-12.				
	Grain.	Stalks	Grain.	Stalks.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Nil	1,478	2,770	1,470	3,515	47 0 1	29 0 7	17 15 6
5 tons farm yard manure per acre	2,012·5	3,520	1,760	3,975	59 3 11	42 15 11	16 4 0
5 tons poudrette per acre... ..	2,960	5,620	2,730	5,590	90 1 0·5	41 8 7	48 8 5·6

At Gokák, safflower cake (sufficient to give 150 lbs. of Nitrogen per acre) used as a supplementary manure to farm yard manure upon sugarcane has confirmed the results obtained last year by not only giving the highest percentage of juice to cane, but also by taking first place in point of yield and it has, moreover, left much the largest net profit. The substitution of half the safflower cake by Ammonium Sulphate has also resulted in a relatively high yield being obtained, but, at present prices, Nitrogen in safflower cake is cheaper than in Ammonium Sulphate.

An interesting result was obtained with Nitre upon dry crop jowar at Surat. The effects of this manure (applied at the rate of 160 lbs. per acre) soon became visible owing to the crop assuming a very dark green and vigorous appearance which it retained till maturity was reached. The results obtained are summarised in the following statement; the net profit is favoured by the high prices prevailing for kirbi:—

Manurial treatment.	Area of plots in acres.	Yield per acre in lbs.		Cost of manure in rupees per acre	Value of surplus grain an kirbi in rupee per acre.	Net gain in rupees per acre
		Grain.	Kirbi.			
				Rs. a. p.	Rs. a. p.	Rs. a. p.
Nil	⅛	367·5	2,074	.....	.....	.....
Nitre, 160 lbs. per acre	⅛	806·0	4,051	9 6 0	57 13 0	48 7 0
Increase of produce	...	438·5	1,977	.....	.....	.....

Note—The grain is valued at 24 lbs. per rupee and the kirbi at Rs. 20 per 1,000 lbs.

Tillage and Cultural Experiments.

In a year characterized by famine and drought, the most interesting results obtained in these operations were those connected with soil moisture preservation or "dry farming" methods. At Gadag, where the total rainfall amounted to only 13·77 inches against the average of 23·43 inches and where cotton was grown as a dry crop without irrigation, being sown about the middle of October, after which time less than an inch of rain was recorded. An experiment was conducted upon the three staple crops of cotton, wheat and rabi jowar, in which the three following cultural treatments were compared:—

I.—Ploughing with an iron-inverting plough in the fair season, succeeded by a large number (12 to 15 times) of harrowings throughout the monsoon, preparatory to sowing in September-October.

II.—The same as for I, with two additions (*a*) harrowing the land in the fair season before ploughing and (*b*) subsequently rolling with a T-bar iron-roller, heavily weighted, as soon as the land had crumbled sufficiently to permit of bullocks walking over it.

III.—The local system which consists in ploughing the land in the fair season (May or June) after the ante-monsoon showers have softened the land and subsequently harrowing some five or six times.

Treatment II requires some explanation. The object of the additional (*a*) and (*b*) operations is to comply with the principles laid down by the American authorities as essential in the science of dry farming. It has been pointed out by these investigators that there is a very great advantage to be derived from turning under a large quantity of loose soil to occupy the space between the unploughed land and the rough soil inverted by

the plough. This secures a very close contact between the ploughed and the unploughed portions and thus enables the capillary moisture to pass up into the latter which action is further facilitated by the T-bar roller, which, with its ribbed surface, has a somewhat similar effect to a sub-soil packer.

The results obtained while not absolutely reliable, owing to the peculiar nature of the season, are perhaps of sufficient interest to make it worthwhile summarizing them in the following statement :—

Name of crop.	Yield per acre in lbs.		
	Treatments.		
	I	II	II
Cotton	128	139	117
*Wheat ... { Grain	94	100	92
*Wheat ... { Bhusa	126	158	115
†Rabi jowár . { Grain	.....	Nil.	Nil.
†Rabi jowár . { Kirbi	.....	170	82

Owing to the very low yields obtained, the extra cultural treatments given in the cases of I and II did not permit of an increased net profit being realized but the results are chiefly of interest from the comparative point of view and demonstrate the importance of taking all practical measures to conserve soil moisture. It will be noted that treatment II has, in very case, given better results than treatment I.

At Nadiád, where the soil is light and sandy and where the total rainfall for the year amounted to only 13·7 inches (against the average of 32·95) of which 10·67 inches fell before the end of August, a piece of land was sown with bájri on the 2nd September after a fall of 1·97 inches of rain on the previous day, which, by the way, proved to be the last for the season. Special precautions were taken during the months of July and August to thoroughly work the land and maintain a deep mulch. The plots were, as a matter of fact, twice ploughed and three times harrowed. Germination was good and the crop, though never becoming tall, appeared very healthy and ultimately yielded at the rate of 240 lbs. grain and 2,938 lbs. of kirbi per acre. Thus in a year, when fodder was all important and a large portion of Northern Gujarát yielded no crop, a moderate outturn of kirbi was obtained, amounting to more than twice as much as was secured on another crop sown in the beginning of the season.

At Dhárwár where these crops (except wheat) are sown in the kharif season quite indefinite results were obtained, but in this case the comparative treatments consisted merely of—

(1) ploughing with an iron inverting plough, and

(2) ploughing with a country wooden plough

with subsequent operations alike in both cases.

Similarly at Surat deep ploughing, though done in January, six months before sowing, did not prove a success, owing chiefly to the seed bed in the ploughed area being insufficiently pulverised.

Much the most striking result however was obtained by indirect methods. This happened on the Dhárwár Farm, where the land had been cropped with potatoes (rain's crop) in the previous year and jowár was the crop grown in the year under report.

For potatoes the land had received the usual good treatment, being ploughed with an iron inverting plough, pulverised and manured all over at the rate of 7½ tons of farmyard manure, while various combinations of artificial fertilizers were applied to different plots, but there was a control plot which received nothing but farmyard manure. The potato crop was harvested in October-November and this operation left the land well broken up, so that it underwent a good fallow for eight months until the jowár was sown in July. It will thus be seen that the land was in excellent condition when sown with jowár for—

(*a*) the soil had been thoroughly weathered and pulverized as the result of the various cultural operations to the potato crop and the subsequent long fallow.

(*b*) there was a good supply of organic matter in the best possible form of humus left as a residue by the potato crop.

These factors could not fail to greatly favour the multiplication of desirable soil bacteria and also to render the soil very retentive of moisture. In spite of these favourable conditions germination was rather irregular due to the deficiency of sowing rains, but the drizzling showers that fell in August improved the crop which subsequently

* Duplicate plots excluded owing to presence of "Karl" salt.
† Original plots excluded owing to presence of "Karl" salt.

took on a fine dark green appearance and grew very vigorously. At first, the crop, which received Superphosphate last year, looked best but subsequently it grew splendidly all over the area (including the non-artificial fertilizer plot, where the outturn was the best) and far outstripped every other jowár crop on the farm. Throughout its period of growth until maturity was reached, the jowár never lost its healthy green and vigorous appearance and ultimately yielded at the rate of 1,401-5 lbs. of grain and 5,363-4 lbs. of kirbi (including chaff) per acre—a truly remarkable outturn in an abnormally poor season when a yield of 500 or 600 lbs. of grain per acre could hardly be obtained.

There is a most important lesson to be learned from these results, for it has been clearly demonstrated that in a season of drought, when the crops were everywhere giving a third to a half of their normal outturns, it was possible to so treat the land without incurring any excessive expenditure, as to make it produce what in a normal season could only be described as a very excellent crop.

In connection with these results some interesting comparative observations were made upon the root development and moisture distribution in the soil of the potato area and in an adjoining area which had been cropped with cotton in the previous year. On the potato area the jowár roots were found to spread out through a hemisphere having a radius of 13 inches, while those in the cotton area were confined to a hemisphere having a radius of 8 inches, so that the growing spaces stood in the proportions of, roughly, 5 to 2. Again, in the case of the potato area there were practically no land cracks and the soil moisture (28th September 1911) was found within 5 inches of the surface, while in the case of the cotton area it was 7 inches below the surface. Under these circumstances it is not surprising that the average height of the plants were over 4 feet and under 2 feet, respectively, and the average yields 1,375-5 lbs. and 339 lbs. of grain per acre, respectively.

Drilling *versus* the Country Method of Sowing.

An experiment was conducted at Dhárwár in which the Gujarát method of sowing cotton by means of a two-coultered drill with a seed bowl, which ensures regular distribution of seed deposited at a uniform depth, and subsequently thinning the crop, was compared with the local system of sowing through bamboo tubes attached by string to the rear of a country harrow (from which the blade has been removed) and held in position by a woman with one hand while she feeds the seed into the top of the tube with the other—a method which naturally results in irregular distribution of seed and many long blanks without any seed at all—and without any subsequent thinning operations. The results obtained in a season when yields ruled low are tabulated herewith, from which it will be seen that the outturn has been increased by 30 per cent. where the Gujarát method of sowing was adopted.

Area under trial in gunthás.	System of sowing.	Average yield per acre in lbs.		Average value of produce per acre.	Average cost of production per acre.	Average net profit per acre.
		Seed-cotton.	Stalks.			
		Lbs. oz.	Lbs. oz.	Rs. a. p.	Rs. a. p.	Rs. a. p.
29·4	Local	140 12·6	471 15·5	15 10 4½	9 15 6½	5 10 10
29·4	Surat (Gujarát) ...	186 0	441 12·5	20 10 8	9 15 2·5	10 11 5·5

In the Panch Mahâls, the local system of sowing maize is by dropping the seed in the open furrow, opened by a country wooden plough. In the year under report this system was compared with drilling the seed. The results, while they cannot be regarded as strictly comparable, owing to the vagaries of the season, are tabulated below from which it will be seen that as regards grain outturn the drilled area has yielded 122·5 lbs. per acre (or 17 per cent.) more than the plot sown by the local system, while as regards yield of kirbi the drilled plots have given uniformly higher outturns amounting to 87·50 lbs. per acre or 13 per cent.

No. of plot.	Crop.	Method of sowing.	Yield per acre.		Value of produce per acre.	Cost of cultivation per cre.
			Grain.	Stalks.		
					Rs. a. p.	Rs. a. p.
23A	Maize ...	Drill ...	704	794	28 2 8	15 1 11
24A	Do. ...	Do. ...	877	781	34 0 10	15 1 11
25A	Do. ...	Do. ...	859	909	34 0 5	15 1 11
26A	Do. ...	Do. ...	838	698	32 4 7	15 1 11
28A	Do. ...	Do. ...	877	749	33 14 3	15 1 11
28A	Do. ...	Do. ...	1,088	646	40 10 0	15 1 11
		Average ...	873·6	762·82	33 13 6	15 1 11
23B	Do. ...	Plough ...	858	768	33 5 4	15 12 3
24B	Do. ...	Do. ...	877	762	33 15 3	15 12 3
25B	Do. ...	Do. ...	512	749	23 5 6	15 12 3
26B	Do. ...	Do. ...	813	691	31 6 4	15 12 3
27B	Do. ...	Do. ...	915	474	35 5 2	15 12 3
28B	Do. ...	Do. ...	532	608	21 5 3	15 12 3
		Average ...	751·2	675·33	29 12 6	15 12 3

Implements.

The Bajac gear plough has continued to give great satisfaction though the cost per acre (as based on further experience) works out at a higher figure than that at first estimated. It is found in practice that two pairs of ordinary cultivators' bullocks are required at each gear and the hire charges which should be made so as to cover all items of expenditure, including depreciation, interest on capital, etc., should be taken at Rs. 4-8-0 per day. Under these circumstances, the cost of ploughing an acre 15 inches deep should be put at Rs. 38. Now the cost of hand-digging varies a good deal, depending upon locality, whether near to, or far from, a big town, and also according to the depth dug and the preceding crop.

The following remarks make this matter clear :—,

Hand-Digging.

Jowár land.—In contract work the rates for hand-digging are—

(*a*) ½ anna per mar (of 4 square yards) for a depth of 10 inches.

(*b*) ¾ anna per mar for a depth of 15 inches.

When the wages of a man are 3 annas per day. At these rates the cost per acre works out at Rs. 38 in case of (*a*) and Rs. 57 in case of (*b*).

These contract rates are about 25 per cent. cheaper than the cost of doing the work by hired labour which therefore amounts to Rs. 50 in case of (*a*) and Rs. 76 in case of (*b*).

Wheat land.—In this case the soil cracks, and the cost is therefore somewhat less.

During the course of the year, Messrs. Ransomes Sims and Jefferies deputed one of their plough experts to visit India and he was fortunately able to spend nearly a fortnight in this Presidency. He visited, in my company, the farms of Nadiád, Surat and Dhárwár, representative of very different classes of soil and as a result of his visit, during which he made many trials with a number of ploughs which he brought with him, it is now possible to form a much clearer idea as to the ploughs most suitable for the various requirements of the Presidency. This gentleman decided to make several alterations and improvements on the standard ploughs built by his firm and some half a dozen improved types have just been received from him ; it seems probable that we have now secured the best type of plough for each of the principal conditions obtaining in this Presidency.

A disc plough, manufactured by Messrs. John Dere and Co., United States of America has done good work on the Goradu soil of Northern Gujarát. In the hot weather this soil, in spite of the presence of a large amount of sand, sets extremely hard and loses all its moisture and hence no ordinary furrow plough (not even the South African Eagle Gallows plough) can make any satisfactory impression upon such land. This disc plough, which cost Rs. 139-10-0 landed in Bombay and which requires only one pair of good bullocks, broke up this land to a depth of some 4 to 5 inches with ease in the middle of the hot weather and left the soil in a very fine loose condition.

Well-Boring.

These operations were continued with the six sets of apparatus which we had in the previous year plus two new sets, of which one was a 4-inch set. All these sets were kept at work in Borsad Táluka until it became evident that there was going to be a famine. Subsequently, Government sanctioned a grant of Rs. 20,000 for extending well-boring operations as a means of famine relief and the Department secured another 20 sets, making 28 in all. These were divided into 4 groups, each in charge of an Assistant Borer, under the general supervison of the Boring Overseer, Mr. Nagindas. At first it was decided to bore only irrigation wells but later on, owing to the shortage of the water-supply of many villages, attention was turned to wells used for drinking purposes only and to facilitate this work 10 sets, together with one Boring Assistant, were handed over to the District Local Board, Kaira, leaving 18 sets with the Department. These were distributed as follows :—8 in Daskroi, 5 in Sánand, and 5 in Mátar Tálukas of the Ahmedabad and Kaira Districts, but owing to the great scarcity of drinking water in Dholka Táluka 7 sets were transferred from Daskroi towards the end of the year and similarly a few sets were sent to Viramgaum and Mehmedabad. During the year ending 31st March 1912 the Department bored altogether 138 wells, of which 90 were successful, 16 partially successful, and 32 unsuccessful. The percentage of successes (including partial successes) thus worked out at 77 against 88 in the previous year, but this falling off is explained by us being compelled to undertake operations in unfavourable localities like the Bhál tract in the hope of doing something to mitigate the drinking water famine.

The best results were obtained in Daskroi Táluka where 95 per cent., of the 27 wells bored, proved successful. The average depth of boring was 70 feet. The average cost of coolie labour for boring worked out at Rs. 0-15-4 per foot or a little less than last year.

The total expenditure for the year ending 31st March 1912 (inclusive of establishment but exclusive of new plant) amounted to Rs. 8,439-4-5, while the total recoveries amounted to Rs. 5,828-9-7 inclusive of Rs. 774-12-6 of last year recovered this year and exclusive of Rs. 2,058-15-6 of this year to be recovered, and hence the net cost to Government amounted to Rs. 1,386-7-10.

In addition, Rs. 18,126-1-4 was spent on the purchase of new plant and Rs. 7,984-12-3 on the purchase of pipes, all of which latter item is recoverable.

As was to be expected in a year of famine, there was a great boom in boring in Northern Gujarát in the year under report, and there are now 75 sets of Cawnpore boring apparatus in that tract, made up as follows :—

Bombay Agricultural Department	28
Baroda State	18
Private	14
Kaira District Local Board	12
Public Works Department	3

MISCELLANEOUS.

The operations against the rice grasshopper were continued at Belgaum with excellent results, which are fully described in an article contributed to the July number (1912) of the Agricultural Journal of India. No progress was made against the Deccan grasshopper (Colemania Sphenariodies) which attacks jowár and other dry crops owing to these crops failing from drought where the operations were to have been carried out.

Work upon the introduction of improvements, among the cultivators, was much impeded by the adverse season, and hence several shows and demonstrations had to be abandoned. The few that were carried out were conducted on the same lines as hitherto. Crops failed from drought on demonstration plots, but a number of these have been organized, chiefly in Khándesh, for next season.

T. F. MAIN,
Deputy Director of Agriculture.

Poona, 20th August 1912.

APPENDIX D.

SUMMARY OF WORK DONE BY THE DEPUTY DIRECTOR OF AGRICULTURE IN SIND, 1911-12.

The season 1911-12 was, in most cases, unsatisfactory. There was a low and short inundation in most of the canals, and fodder of all kinds was exceptionally scarce. There was little rainfall and the natural grass in the deserts and non-cultivated places was very poor.

More money has been available during the last two years and a considerable amount of new work is on hand. Progress is, however, being considerably delayed owing to want of staff. The method of recruiting the staff, by sending Sindhi Matriculates to take their degree in Agriculture at Poona College, has not turned out very successful and other means will probably have to be adopted.

The attempt to improve agricultural conditions in a province like Sind is a very complex problem, on which many circumstances depend. Agriculture here is dependent on irrigation and the type of the water-supply determines greatly the type of cultivation. The following can be said to be the chief types :—

(1) Good rice flow when rice is well cultivated and broadcasted and a pulse crop after grown dry in the cold weather.

(2) Rice swamps when coarse varieties are broadcasted.

(3) Kharif cultivation, flow or lift kharif cereals as bájri and jowár may be grown.

(4) Bosi and Sailabi where the soil is retentive enough by flooding in the hot weather to grow a crop as wheat in the cold weather without further irrigation. The further from the river the less retentive is the soil, and in many places the soil dries so that Bosi cultivation is not possible.

(5) Cultivation when perennial water is available. On a new canal like the Jámráo, owing to its alignment, water is present all the year round, instead of about 3 months per annum as in ordinary innundation canals. The new canals will all be of this type.

Other economic conditions to be considered are the scarcity of population, the fact that non-rice lands are allowed to lie fallow for several years between crops and the system of land tenure. The land is held by zamindárs who generally rent it on share of produce to an annual "hari" or tenant, advancing him money in the beginning of the season. This

makes the zamindárs unwilling to adopt anything new without much persuasion as he ceases to have any interest in his land from the time of obtaining his "hari" till the time of "batai" or division of crop. On the "haries" also fall works of levelling and general improvement when this is carried out. The stock example of the enterprising zamindár and successful cultivator, Bahadurkhan Khoso, of Thul, Upper Sind Frontier, has shown that it pays the zamindár to do work by his own labour and not to depend entirely on the "hari". This man, from small beginnings, owns now 50,000 to 60,000 acres and is steadily extending. He is not afraid to put on a hundred pairs of bullocks on a work where necessary or build stores or godowns on his lands or spend his own time in personally inspecting details of his estate management.

The central farms at present established are Mirpurkhás in the centre of the perennial canal the Jámráo; Sukkur on the river Indus irrigated by a pump; Lárkána on the outskirts of the best rice district in Sind, with a portion of typical Bosi land; Lándhi for garden and fruit cultivation in the fruit and potato growing area round Karáchi; and Daulatpur, formerly a reclamation station to deal with alkali problems, and now a seed station.

For demonstrating the results obtained on the farms, sub-stations are established on plots of ground rented or loaned. Others will shortly be started in Lárkána and Karáchi Districts.

Mirpurkhás.—A separate report for this farm, dealing with work in detail, is issued. The chief work is in cotton and rotations. It is the head-quarters of the Department.

Sukkur.—A separate report is also issued for this farm. It was a rough piece of ground to start on and most of the crops are still patchy, especially at germination. It is a useful station for the demonstration for the suitability of various crops in Upper Sind; the cotton crops were good last year and berseem did excellently.

Lárkána.—This is a remarkably good situation near Lárkána town. It contains a portion of first class rice land and some good kharif and Bosi land. Besides this, an area of perennial cropping will be laid down with irrigation from a well. The Abrowah (from the Ghar Canal) flows through the farm and is an excellent inundation canal.

Lándhi.—The land has been acquired and work will be started shortly. Problems in the cultivation, storage and seed of potato will be dealt with, with alternative crops like groundnuts, etc., also fruit and vegetables.

Daulatpur.—The Kalar or Alkali question has been worked out and a completion report has been compiled, showing a profit on the work. It has however more reference to future canals than to the Jámráo, as in the latter, owing to its constructions, the land commanded has to be fallowed for two years, irrigation water being allowed for one-third the gross area. The farm is now being run as a seed station.

No new central farm is likely to be established in the near future as the above cover most of the ground. A stock farm for dealing with the excellent strain of Karáchi milk cattle is badly needed. These are being bought for use all over the East, including Japan, at high prices, and it seems likely that the best cattle are being drained out of the country:—

The sub-stations were:—

Bádin.
Tándo Mahomed Khán.
Matli.
Nawábshah.
Nausháhro Feroz.
Halla.
Jacobabad.
Shikárpur.
Ubauro.

Bádin and Halla were more or less failures owing to shortage of water and labour troubles.

Matli.—American cotton, Texas big boll produced 400 lbs.; other crops were moderate. The pulse Val did well.

Tando Mahomed Khan, the headquarters of this sub-division, did fairly well; 29 demonstrations were held during the year; 16 scrapers 145 ploughs and 6,630 lbs. of various seeds, mostly cottons, were distributed.

Nawábshah, Nausháhro and Halla.—Nawábshah was the head-quarters of the sub-division. Sindhi cotton from selected Halla seed gave 918 lbs. Triumph American gave 856 lbs. and Boyd Prolific 954 lbs. A white Upper Sind Frontier jowár gave 1,489 lbs. grain and a bajri over 1,000 lbs. A number of the Presidency pulses, especially Val, grew well.

55 demonstrations were given, 7 scrapers and 73 ploughs and 1,700 lbs. seed distributed.

Jacobabad, Shikarpur and Ubauro.—At Jacobabad the cotton yield averaged 8 maunds (Md. = 80 lbs.), Sindhi and American. The pulse Val and Tur were good. Ubauro gave 6 maunds of American cotton. At Shikarpur outturn of 8½ maunds of Sindhi cotton was obtained and 6 maunds of selected jowár.

34 demonstrations were held and 113 ploughs sold.

Cotton.

The cottons cultivated on the various Farms are Egyptian (Mit-Afifi and Abassi), Upland American and local Sindhi.

Egyptian cotton.—This was sown at Mirpurkhas and Sukkur. The latter grew over 9 feet high, but was too thick to give a good yield. At Mirpurkhas one plot of Afifi gave 800 lbs. per acre and one of Abassi 643 lbs. per acre. No Egyptian was grown in the district. Its growing season is too long.

Upland American, Texas Big Boll, Boyd Prolific and Triumph were grown in district. Boyd Prolific is a good yielder; it is a semi-cluster variety and does not branch much and so stands crowding much better than the others. It is most essential that American cotton should be sown wide apart: in the past it has been sown much too close.

The stapled varieties of American cotton, *i. e.* with a length of staple over 1⅛", are more delicate and do not yield so much. Those grown on Mirpurkhas Farm were:—

Black Rattler.

Griffin.

Allen Long Stapled.

The chief advantage about American cotton is its short period of growth; it can be sown up to June and is so suitable for growth in most parts of Sind where the canals generally fill at that time.

The yields of the cottons were:—

Yields in lbs. seed cotton per acre.	Triumph.	Texas Big Boll.
Mirpurkhas	618	865
Sukkur	386	534
Matli	...	404
Nawabshah	856	964
Jacobabad	...	560
Ubauro	...	560

Messrs. Gaddum & Co., Ltd., Karachi, after seeing samples of American cotton grown in the district reported:—

"We have seen samples of 'kapas' shown us by Mr. Schmidt and think the cotton would compare very favourably with Middling American cotton and would fetch at ordinary time at least 1*d.* to 1½*d.* per pound more than ordinary Sindh cotton in Europe. It is better staple than the American seed cotton grown in Tinnevelly (Cambodia).

We think a good market could be made for this cotton and any exporters would buy it readily at profitable rates to producers, especially if it were obtainable in fairly large quantities, some certainty of its being free from ordinary Sind cotton.

We shall be very pleased if you can put us in the way of purchasing some of this cotton even if only ten bales which we would forward to our Manchester house and get their views as to what prices it would bring in Lancashire.

Of course, a season like the present one is most difficult as the price at present of ordinary Sind cotton is the same as 'Middling' American: in other words the price of East Indian cotton is not on a parity with American and should be 1*d.* per lb. lower.

The serious difficulty experienced by us in dealing with growers of American seed cotton has been that we have been offered this cotton on a sample and when bulk has been inspected it has always had a percentage of inferior ordinary cotton mixed with it.

If growers could be persuaded not to do this and buyers could be sure of obtaining pure American seed cotton unmixed with lower kinds, it would be a help to fixing a standard rate compared with ordinary cotton.

In Broach where the class of cotton is high and the staple good, the natives bring large quantities of inferior 'kapas' in from other districts and mix it and thus make good profits. The seed also ginned from this cotton deteriorates yearly and gradually the original pure Broach cotton is disappearing.

If this is done with American seed cotton it will never in our opinion be a success and prices that would be profitable to dealers would never be paid. We learn that Messrs. Tata of Bombay are buying the cotton grown on the Experimental Farms at Lyallpur at Rs. 6 per maund above the rate for ordinary cotton, on the condition that the cotton is not mixed.

We have had some experience of American seed cotton in Tinnevelly District where it is increasing rapidly and is readily bought by Mills' exporters at evidently profitable rates to growers as it is yearly increasing.

This cotton is very well liked by Spinners at Home and commands 1*d.* per lb. more in price than ordinary Tinnevelly cotton.

The amount of this kind of cotton has been so small up to now in another district except Tinnevelly that it has hardly been worth exporters' while to bother about it. However with reasonable prospects of quantity increasing and quality being kept up, we are quite convinced that a good business might be done at rates which would compare favourably with ordinary Sind cotton from the cultivators' point of view.

We shall be glad at any time to do anything in our power to help you in this matter or to hear from you at any time."

(Signed) GADDUM & Co.

Arrangements were made to order 40 tons of Triumph seed from America through the British Cotton Growing Association, 10 of which are for distribution to zemindars in Upper Sind and 30 tons on the Jamrao. Also a Bombay Syndicate was prepared to erect a gin at Jacobabad to gin this cotton and to sell the cotton on the Liverpool grade at the market price of the day. This would obviate auctions and would ensure a proper market value being obtained for the produce.

Unfortunately the seed arrived too late, but the same arrangements will be carried through next year.

Three bales were sent to Liverpool and obtained the price of Middling American. The costs on such a small consignment were however high. The charges were:—

3,576 lbs. American seed cotton.

This was ginned and produced.

1,159 lbs. lint,
2,321 lbs. seed, and
96 lbs. waste and dust:

i. e. 31·3 per cent. ginning.

For 1,159 lbs. lint @ Rs. 26 per 81 lbs. offered locally = Rs. 370-0-0.
Weight 1,117 lbs. net in Liverpool @ 6*d.* per lb. = £ 27-18-6 = Rs. 418-14-0.
Expense in India, pressing, rail, etc., Rs. 14-4-3.
Freight Rs. 12-0-0.
One per cent. commission Rs. 3-14-0.
Sampling in Liverpool Rs. 4-3-0 = Rs. 34-5-3 = Rs. 383-8-9.

Rs. 383-8-9

i. e. expense on a 400 lbs. bale to Liverpool excepting ginning would be Rs. 11. The difference would have been greater, but it was sold on a falling market.

Sindhi Cotton.—Cotton is gradually spreading north along both banks of the Indus and east on the Nara. The estimated yield for Sind was 150,000 bales. It is probable that the area will be very largely increased. There seems to be no reason why it should not be largely grown in Upper Sind. Messrs. Ralli Brothers' gin at Mirpurkhas has been doing good work in distributing good Hala seed in the Thar and Parkar District. Short of a seed farm at Hala it is as good a method as could be adopted for distributing good seed. The price of Sind cotton seems to have permanently gone up; it is generally paid at from Rs. 8 to Rs. 10 per maund seed cotton. In the old days it was nearer Rs. 5. This appreciation seems independent of the common market fluctuations and may be due to extended uses in new markets such as Japan or it may be used along with other Indian grades.

Fodder Crops and Rotations.

The fodder question becomes more serious every year and will continue as the country gradually fills up. There are no purely fodder crops in Sind and stock are grazed on the fallow ground and waste places, and when rainfall is poor, grass is scarce. The grazing is supplemented by jowar and bajri kurbi or straw and that of wheat and rice according to the district. In Upper Sind gram is grazed down once before it is taken for seed and Muttar is also used. In Lower Sind these do not grow well and generally in the cold weather the cattle are half starved till the 'palera' or babul pods are ready about February. This is an excellent fodder and is sold in the bazars.

Where rabi water is available berseem is an excellent fodder crop and it also enables the land to be cultivated intensively. It makes excellent hay. The only difficulty about

it is that it is a somewhat shy seeder. When left to seed for 2 or 3 months before cutting it should produce about 2 maunds per acre of seed. The rate of sowing is about 40 lbs. per acre. Berseem grew well on all farms last year. Some of the Sukkur plots gave over 80 maunds per cutting per acre and it was valued at 10 to 12 annas per maund green in bazars.

There should not be any trouble about fodder in Sind. Jowar will give 3 cuttings if well watered in hot weather. Val, a good growing pulse, can be cut all the year round, but is killed out by frost, and berseem, when cold weather water can be had, is the best of fodder and hay. In bosi land gram can be grown. In the dry climate of Sind jowar kurbi and other fodders will keep indefinitely.

At Daulatpur about 150 acres of berseem were growing. It was eagerly bought up and a number of starving cattle were saved by it. Formerly buyers could not be induced to tether their cattle on the plots. They insisted on cutting and taking the grass away. Now however they prefer to graze the cattle in the fields with the resulting benefit to the land.

Hot Weather Cereals.

Chapti, Sholapuri and Perio jowars from the Presidency continue to do well, but the local jowar is much quicker in growing. A white Upper Sind jowar which grew to a height of about 15 feet is good.

The local bajri is as good as any tried.

Maize grew poorly except in specially rich soils.

Wheats.

Four of Mr. Howards Pusa wheats were tried.

They did not yield very satisfactorily as there was a shortage of water. Selected Sindhi white grown at Sukkur yielded well and gave remarkably good heads. One half acre plot yielded at the rate of 17 maunds of 80 lbs. per acre. A large number of wheat varieties were grown at Mirpurkhas some of which will be tried on larger scale. In the permanent wheat plots in which wheat is grown each year the unmanured plot still yields as much as the other which is owing to the several ploughings it receives in the hot weather.

Miscellaneous.

The common oil seeds, fibre crops and pulses were cultivated. Tur and Val are most useful introductions. Safflower grows well. Sugarcane for sets is grown at Mirpurkhas and Sukkur. A Poona variety named Pundhia is grown. Cane cultivation may extend on the Jamrao. A power crusher has been erected on the Jamrao by a zemindar, but there is little market for 'gur' and to make a success a complete installation of vacuum pans and centrifugal separators would be required.

New trials were Australian fodder grasses, soy beans, velvet beans and Chinese oat. Japan Clover is not suitable for the country.

Irrigation figures are as per statement attached.

Statement showing the result of Irrigation Experiments carried out on Mirpurkhas Farm, 1911.

No. of Plot.	Crop.	Previous cropping and cultivation.	No. of waterings.	Date of sowing.	Date of last watering.	Total rainfall in inches.	Produce in lbs. per acre.	Remarks.
1	2	3	4	5	6	7	8	9
D. 4	Egyptian Cotton Abassi.	Berseem in Rabi, 1910. Twice ploughed, samared and ridged. Seed dibbed on ridges.	15	12th May 1911.	14th December 1911.	0 52	522	Berseem sown on 25th August 1911. Last 3 waterings for Berseem.
D. 5	Sindhi Cotton ...	Berseem in Rabi, 1910. Twice ploughed, and seed sown after the last ploughing and samared.	12	10th May 1911.	21st December 1911.	0 52	842	Berseem sown on 3rd October 1911. 4 last waterings for Berseem.
D. 6	American Cotton Texas Big Boll.	Berseem in Rabi, 1910. 4 times ploughed and seed sown after the last ploughing and samared.	12	13th May 1911 and 1st June 1911.	4th December 1911.	0 52	393	The plot was first sown on 13th May with Boyd Prolific, but as the seeds did not germinate it was resown with Texas Big Boll. Berseem sown on 24th October 1911. Last 3 waterings for Berseem.
D. 7	.....	.....	...	.....	.....	...	.....	
C. 6	Sholápur Jowar ...	Berseem in Rabi, 1910. Twice ploughed and seed broad casted and then samared	13	18th May 1911.	3rd December 1911.	0 52	580 lbs. grain and 10256 fodder.	This crop is much later in ripening than Sindhi Jowár. No Berseem in Rabi, 1911.
C. 11	Local Bajri ...	Berseem in Rabi, 1910. Twice ploughed and seed broad casted and samared.	9	6th June 1911.	4th October 1911.	0 46	208 lbs. grain and 1,903 fodder.	No Berseem in Rabi, 1911.

The actual quantity of water was not measured. It was however estimated at slightly under 3" per watering.

Fungoid Pests.

As usual, Mahlo or mango hopper, rust and smut in wheat, stem borer in jowar and cane and potato moth from Karachi.

In addition boll worms in Sindh cotton was very bad as it was in the Punjab. Attack runs in cycles.

Garden and Fruit.

Peaches, citron family and grapes are all doing well. The grapes are especially good. As they seem to stand rail fairly well it is intended to try and supply the Bombay market. The local prices obtained are poor. Vegetables do well.

Poultry.

A white strain of Persian Gulf fowls for eggs has been bred and are kept on all farms. They lay well and it is intended to increase their yield by means of trap nests. Upper Sind game are kept for table.

A fair number of turkeys have been raised. Some Mammoth Bronze turkeys were obtained from Pusa last season and chicks will be raised next year. It is believed that the climate is too extreme for English fowls.

Implements and Seeds.

A considerable amount of seed was distributed from all the farms and sub-stations. In fact most of the produce of the latter is used for seed.

The chief implements sold are the plough, scraper and norags or thrashing machines. Of the ploughs over 500 were distributed last season and a number of old ones repaired. European implements are on show at all farms chiefly winnowing machine, reaping machines, iron ploughs, cultivating implements and drill sowing machines. The fact that the land is worked by the Hari and not by owner is against the introduction of modern implements. The wheat reaping machine will cut 4 acres per day. It would take about 25 men to do this with hooks. With cultivating machinery and drills the difficulty is, all crops except bosi are sown broadcast in small plots with bunds round them which makes difficult work for cattle. The North Sind cattle are small and poor and both in north and south no cattle are trained to plough anything approaching a straight urrow. In bosi the seed is dropped behind the plough into the wet layer below the dry top mulch, in other cases seeds are broadcasted and drilling does not seem to be suitable owing to quick drying of soil, which is unfortunate as it makes intercultivation expensive.

In water lifts for short lift the Archimedian screws have proved very successful and for lifts up to 12′ a Noria lift is efficient. On Sukkur the portable steam engine and centrifugal pump has worked cheaply and efficiently. Trials will be made with a power thrashing machine.

The plough is an important implement and one of the simplest and most important improvements possible in Sind. Agriculture is to induce land owners to keep their fallow ground ploughed. The wooden plough of Egyptian model is quite suitable for hot weather ploughing of fallow land. With few exceptions this land is invariably allowed to grow into jungle. If zemindars could be got to keep this fallow land broken up it would be a great advance.

Shows.

Departmental exhibits combined with classes for zemindari produce were held at—

Sukkur.
Naushahro Feroz.
Badin.

They were well attended.

Vernacular School.

School building and quarters for vernacular school have been erected at Mirpurkhas. The course will be a 12 months' one in agriculture for sons of zemindars about 20 years old. The instruction will be in Sindhi and about 10 boys will be taken the first year.

G. S. HENDERSON,
Deputy Director of Agriculture.

APPENDIX E.

SUMMARY OF WORK DONE UNDER PROFESSOR OF AGRICULTURE, BOMBAY PRESIDENCY, 1911-12.

Sugarcane.

Rotation Experiments.

As proposed last year, the quantity of manure applied to the plots in which green manure and fallowing enter into the rotation was reduced by ¼ and ½ respectively, the reduction of nitrogen supply being compensated to the fallow plot by an application of 500 lbs. of ammonium sulphate, without reducing the yield.

From this it may be concluded that a good crop of green manure is equal to 15,000 lbs. of farm-yard manure valued at Rs. 30. But if a crop of fodder is taken instead of the green manure Rs. 50 can be netted, leaving a balance of Rs. 20 in favour of the latter system. The high cost of the sulphate absorbed any advantages from fallowing.

Manure Experiments.

(a) Trial of mineral manures as sources of nitrogen.—The only manures of this class tried during the season under report were sulphate of ammonia and crude nitre, applied on the basis of nitrogen content. As compared with safflower cake, the sulphate gave a higher outturn of cane and of gul at a less cost. Crude nitre was about equal to the sulphate in point of outturn, but it cost ⅔ more. Experiments in cultivator's fields with ammonium sulphate on cane grown under well irrigation were continued—used both as a single manure for top dressing and in combination with oil cake. In many places the top dressing of this crop is unknown. The application of some form of top dressing increases the yield and the net profits very considerably. Ammonium sulphate is one of the best manures for this purpose. But a combination of sulphate and cake is better than either alone. These results entirely corroborate those of previous years.

(b) Advantages of top dressing and times of applying.—At Manjri the reserving of a part of the manure for a top dressing rather than the application of the total quantity at once has shown an increase of nearly 50 per cent. under heavy canal irrigation; but the giving of the application in two dressings did not improve on the above system. Top dressing under well irrigation has been discussed above in (*a*).

(c) Potash and phosphoric acid experiments.—There was an error in carrying out these experiments which vitiated the question so far as potash is concerned; but the figures for phosphoric acid show that when added to a manure rich in potash and nitrogen, phosphoric acid will increase the outturn with profit.

(d) An experiment to find the manurial value of the dried leaves of sugarcane (pachat) as compared with farm-yard manure was carried out.—The improvements possible in furnaces now in use enable the cultivator to save quite a considerable part of his trash for manure. Since farm-yard manure is becoming high in price and hard to obtain, if pachat can in part or wholly replace that manure, it would be a gain to the sugarcane tracts. When applied in quantities equal to the usual application of farm-yard manure it gave very nearly the same yield although it furnished 100 lbs. less of nitrogen.

(e) Experiments to reduce the total quantity of nitrogen necessary to grow cane under canal irrigation.—This is possible by also reducing the quantity of water applied. When only one-half of the usual quantity of water which is given by the cultivators is applied and the nitrogen reduced by 100 lbs., making a total application 200,000 cubic feet of water per annum and 250 lbs. nitrogen per acre, the outturn was practically the same as with the usual application of manure and water.

(f) Experiments to determine the value of safflower cake.—Fish and safflower cake were compared with a result that safflower cake gave more yield at less cost, the basis of application being nitrogen content.

(g) Quality of gul.—We are finding this line of research exceedingly difficult. In colour ammonium sulphate ranks first; fish manure and safflower cake produce darker coloured gul. In point of hardness the order is castor cake, safflower cake, fish, and ammonium sulphate.

The juice from the plots treated with safflower cake is richest in sugar and only slightly poorer with fish and ammonium sulphate: then comes castor and nitre.

But these results need careful verification next year before they can be taken as final. The same points were observed in different types of soil, but the question of maturity or ripeness nearly vitiated these results.

Experiments with different kinds of sets.

(*a*) In Poona the whole cane is cut up into pieces about 12 inches long for planting, while in other places only the terminal pieces are so utilized. The latter are considerably poorer in sugar than the rest of the cane; so if they produce as good plants there would be a considerable advantage in using them. The results of the year not only show that they are as good, but that they even produce a distinctly better crop than sets from the whole cane.

(*b*) Another question is—should new cane or ratoon cane be used for sets? It is the custom to use the latter in many cane-growing sections, but our experiments are in favour of sets from new cane.

(*c*) The cane planter, very seldom, makes any selection of sets in planting. It was thought that if the sets were carefully assorted and only sets of good size with good buds were planted, an improvement would be effected in the uniformity of the crop. This opinion was confirmed, the selected sets yielding more cane and more gul.

Cane crushing.

The power crusher continues to work satisfactorily; an average extraction of 70 per cent. of juice to cane was obtained for all cane crushed this year. The advantages of this system of crushing to large cane growers are:—

(1) The cane can be crushed when it yields the most sugar.

(2) Being done quickly, the staff is early released for planting.

(3) Supervision and guarding against pilfering are much easier.

(4) Green fodder worth Rs. 30 per acre is saved for feeding.

Manufacture of gul.

The Poona system of manufacture was demonstrated at nearly 50 centre in Násik Sátára and Ahmednagar and assistance in its demonstration was given to the Deputy Director in Belgaum and Dhárwár districts and to the Superintendent of Farms of North-west Frontier at Taru near Peshawar.

New furnace.

Further trials of the triple furnace mentioned in last year's report demonstrated conclusively that a considerable saving in fuel, time and labour is effected by its use; a further improvement on it has resulted in the Multiple furnace by means of which the time is reduced to 1 hour and 30 minutes per pan of 1,100 lbs. as opposed to 2½ hours for the usual type; 300 lbs. of fuel as opposed to 500 lbs. for the Poona furnace.

The double furnace is recommended for Sátára as very little extra expense is required since they have already a storage pan, so only the flue and chimney extra are necessary.

Where the Poona method is in vogue the present small storage tanks (nands) will need to be replaced with the large storage pan and the flues and a chimney added. This means a gain of ¼ of the fuel and a saving of ⅓ of the time. Moreover the work of feeding is less, and the quality of the resulting gul superior. The triple furnace is recommended for the Sholápur system of work.

But the new Multiple furnace will be best for power plants. It may be worth mentioning in explanation of the above that the limits, as to suitability of the different furnaces for different localities depends upon the size and make up of the gangs, the capacity of the mills and the method of working.

Groundnut.

Work with this crop comes under four heads:—(1) Spacing; (2) Varietal; (3) Effects of groundnut on the soil; (4) Seed distribution. Owing to the adverse conditions of the season for the year the yield of this crop is low in all cases.

(1) This year thick sowing has in all cases been most profitable. This differs from last year's results in the case of irrigated land, but on account of the season no plants developed to the maximum size so that in order to take the advantage of all the space it was necessary that the seed should be put in thickly. Nine inches by six inches for large varieties and six inches by four inches for the smaller varieties gave the best results.

(2) *Varietal.*—Probably on account of the poor season which prevented full development of the large sorts, the medium sized varieties like Pondicherry and Mauritius equal the large kinds such as Virginia and Big Japan and therefore are perhaps more suitable to regions where there is a liability of insufficient rain or irrigation.

The small varieties, small Japan and Spanish peanut are not as good yielders as the other varieties where the latter can be given plenty of water. But where the wells are limited or for cultivation under precarious rainfall these varieties will produce about four-fifths as much crop as the big ones ; another point in their favour is the ease of harvesting.

(3) *Effect upon the soil for succeeding crop.*—These experiments were taken up to investigate the prejudice in Sátára and other parts that the exotic crops were not as good rotation crops as the indigenous varieties.

In three sets of experiments with the following crops succeeding groundnut—kharif jowári, shálu jowári and bájri and fodder jowári—yields of bájri of 1,400 to 1,900 lbs. per acre of grain were obtained on soil where the exotic varieties had been grown the previous year. In the case of shalu succeeding the nuts, the yield after the local variety was superior to that from the plot where Virginia was grown.

(4) *Distribution.*—Nearly 30,000 lbs. of seed of the different varieties was distributed, about one-third of which was the large varieties. One-half was distributed in Poona District. Násik and Sholápur took over 4,000 lbs. each and Ahmednagar nearly 3,000 lbs.

Bajri.

Work with the crop consisted in a further trial of the Akola and Nadiad varieties on College Farm which have again been demonstrated to be considerably superior to the local sorts and continued attempts to establish a pure awned variety at Manjri.

Jowars.

This crop was chosen for the experiments in conservation of soil moisture which please see on page 46.

On College Farm several varieties were grown by the students and the following results noted. Large Cawnpore is the largest yielder, but the quality is poor. This is followed by Baidra which is of better quality, while Paramsal gave the largest outturn of dry fodder.

Rice.

The rab experiments were reduced to a very small area, but plots treated with hydrocyanic gas gave seedlings nearly equal to rab ; these experiments are being repeated.

Wheat.

Rust again seriously reduced the yield of the Manjri wheat. The Australian varieties suffered most except Sia Das. The average yield was less than 1,000 lbs. per acre. This crop was also used in moisture conservation series which please see.

Gram.

There is no experimental work with this crop, but it enters into the rotation at Manjri farm with sugarcane where the average yield was 619 lbs. per acre.

Chillies.

One experiment on the value of artificials to this crop showed clearly that a part of the farm-yard usually applied can be replaced by chemicals with advantage. From the students' experiments it would seem that nitrogen is the controlling element with the chillies.

Lucerne.

Work with this crop was carried on in two lines : (*a*) different systems of sowing, (*b*) manure experiments. Over 10 per cent. greater outturn was obtained by the ridge system and the latter plot is much freer from weeds.

The value of superphosphate for this crop when used in combination with half the usual quantity of farm-yard manure was clearly demonstrated. An artificial manure properly made up, for example, superphosphate 400 lbs. and sulphate of potash 200 lbs. per acre, costing Rs. 341, will produce higher yields at a less cost when substituted for part of the dressing of farm-yard usually given. Lucerne seed from Quetta was tried, but proved inferior to local.

Cotton.

In connection with the teaching of plant selection, the history of certain single plants has been traced for three generations and we now have plants which show a decided gain in points of outturn and percentage of lint.

Cambodia and Buri cottons were grown on the College Farm in comparison with Varadi and Broach.

Buri produced about 500 lbs. of seed cotton per acre which is more than Varadi and slightly less than Broach, but Cambodia only gave about one-half this yield.

An experiment to compare Broach with the local variety which is of the herbaceum type of the cotton-growing parts of Satara was carried out, but the adverse conditions of the year gave little value to the results which were in favour of the local.

Karkheli, Buri and Cambodia also gave promise of equalling the local and doing better than Broach.

At two centres in Nagar and one in Sholapur the various Varadi types were under study, but the season was very trying to all varieties. However, Roseum produced over 400 lbs. of seed cotton and is undoubtedly a very valuable variety for these tracts. Broach cotton in Poona on area of 2 acres averaged nearly 600 lbs. per acre, one plot giving 960 lbs. and this without irrigation.

Tobacco.

Manurial experiments were undertaken by the Divisional Inspector in Satara District. The results, although confusing, indicate that a properly made artificial dressing could be used with advantage to supplement the farm yard, thereby permitting of a reduction of the quantity of the latter. Gurhal ashes and safflower cake have given good results with this crop.

Potatoes.

Sulphate of Potash increases the yield, but it will not pay to apply over 160 lbs. per acre. Sulphate of Ammonia when used with a smaller dressing of farm-yard manure than usual will be more profitable than the entire dressing of manure. The bed system gave nearly double the yield of the ridge system at Manjri where a yield of 12,895 lbs. was obtained or 213 bushels per acre.

Onions.

Sulphate of Potash increased the yield of this crop, while, when used in connection with Suphate of Ammonia, the crop is more than doubled. But even then unless the artificials can be obtained at lower prices than at present prevails, they are not as profitable as farm-yard manure. The yield of onions cultivated by the students averaged nearly 20,000 lbs. per acre and one plot reached 27,480 lbs.

Micellaneous crops.

A specimen of Burbank's spineless cactus has been received and is growing well. A beginning has been made in the study of leguminous weeds as fodder plants. Turmer is grown as a demonstratum at Manjri. The profits from this crop are from Rs. 150 to Rs. 200 with an outlay of about Rs. 175 for cultivation. As the time occupied for the crop is only five months, it could with advantage be taken up in the canal tract.

II. MANURIAL EXPERIMENTS.

The results of the year need a few words of summary although they have mostly been mentioned above. The results with artificials show that for garden cultivation a manure properly made up out of Sulphate of Potash, Superphosphate and Ammonium Sulphate may be used with profit to replace one-half of the usual dressing of farm-yard manure. As garden cultivation increases and the supply of manure thereby becomes short the value of these applications will be more and more appreciated. With a greater demand the prices of their dressings will be brought within the reach of all.

2. Every effort should be made to conserve waste matter from crops like the sugarcane (pachat) as much organic is annually lost by such materials as pachat, husks of groundnut and safflower seed being used as fuel. I also call to notice the wasteful practice of burning the stalks of safflower.

3. A large amount of valuable manurial matter is annually lost everywhere in the failure to properly preserve the cattle urine. Experiments were carried out, which clearly demonstrate that the urine of a pair of bullocks when applied to a crop of jowari is more valuable pound for pound than the dung from the same pair. When applied to cotton on a definite sized plot the urine voided by a pair of bullocks in a definite time increased the yield over the non-manured plot more than the dung from the same bullocks for the same time did when applied to a plot of the same area.

In the latter experiment the urine was absorbed by dry earth which was applied.

4. The value of green manuring with San (Crotalaria juncea) for rice was demonstrated at Wadgaon (Poona) where the yield was nearly tripled.

III. SOIL MOISTURE CONSERVATION.

A large part of the work of the year has been along this line. Extensive experiments in Ahmednagar and Akalkot were supplemented by experiments at the regular farms. The year under report was particularly favourable for such work on account of the scantiness of the rainfall.

The advantages of thorough ploughing to enable the soil to hold all the rainfall possible was again proven, although very good results can be obtained by thorough harrowing. The advantages of thorough and frequent intertillage to prevent evaporation has been clearly proven. The crop of Broach cotton at Poona of 600 lbs. with a rainfall of 13·72 inches is a sufficient proof of the possibility of retaining the moisture through frequent stirring the soil.

In times of scanty rainfall or in regions where insufficient moisture is the rule the certainty of a crop can be largely insured by thinner seeding.

This can be done by either sowing the rows at double the present distance 9″ or which facilitates the operations of intertillage or by using only half the quantity of seed at the same distances apart as sowing is now done.

In some "Dry farming regions" it is recommended that a crop should be taken on the same land only every alternate year, the field being left fallow the odd year. The fallow to be kept throughout the year free from weeds and protected by a dust mulch. This was tried and 770 lbs. of grain was obtained as compared to 430 lbs. of grain of last year plus 303 lbs. of grain of this year, thus giving 37 lbs. in favour of fallow.

An interesting observation has been made on College Farm bearing on the subject of holding over soil moisture in the soil from one year to another. Uniform treatment and cropping was given to an area one-half of which had been irrigated the previous year while the other half was cultivated dry, but growing the same sort of crops; the part that had been irrigated the previous year was able to resist the trying breaks in the unfavourable monsoon, whereas those in the adjoining area which had not been irrigated the year before succumbed to the drought or were badly injured and in the end the yield was only one-half of that of the plots of the irrigated portion.

At Manjri attempts to reduce the water requirements of irrigated crops by cultivation during the interval gave considerable promise.

IV. FODDER.

Another line of study of the year has been the question of fodder-supply. This may be divided into (*a*) growing of fodder, (*b*) preserving of fodder.

The first is a very comprehensive set of tests to find out the best fodder for sowing at any month. The experiment was begun in January and comprise 18 crops: maize has produced the largest yield of fodder so far, and is the earliest.

The period required for each crop and the height will be recorded and the completed results will be reported later.

6. *Storage of fodder.*—Five systems of storage of fodder are under trial and the results will be reported later.

V. IMPLEMENTS.

A considerable amount of time has been devoted to implements. Under ploughs the following new types seemed to be adapted to certain conditions. Ransomes, Sims and Jefferies S. A. E. gallows plough is very efficient for deep ploughing for sugarcane. In demonstrating of ploughing at Sholapur with this plough it was found that it could prepare land for this crop at a cost of Rs. 11-12 per acre as compared to Rs. 23-9 for the local system, that is, a saving of exactly one-half.

The Arlington No. 30 with iron handles is now a successful competition with Ransomes, Sims and Jafferild CT2 for ordinary Deccan black soil where the wooden plough requires from six to eight bullocks. Two ploughs by Rud Sack of Germany—one No. W.W. 7 and which is a Brabant two-way plough with a gallows, and the other D. 10 N.W., a one-way plough—turn a larger furrow with less draught than the CT2, but their price is Rs. 7 and 8 higher than the CT2 respectively.

Disc Harrows.—These implements have proved of great value on our farms for the following purposes:—

(*a*) Reducing ploughed land to a fine tilth in a short time with a minimum draft.

(*b*) Mixing coarse manure thoroughly with the soil which no Indian implement can do.

(*c*) Enabling the cultivators to establish a fine mulch on his land immediately after harvest, thus conserving moisture and reducing the labour of ploughing very considerably.

(*d*) It can be used for a sub-surface packer dry farming operations.

Planet Jr hand Intertillage Hoes.—The value of these little implements has been demonstrated beyond all question for work in cotton and grain crops both as weed eradicators and as moisture preservers.

Miscellaneous.—Experiments with Reapers give hopes that these great labour saving machines can be used with advantage for harvesting in India if they can be bought and maintained co-operatively by villagers. The value of the Sindh Norag Thresher has been demonstrated without a doubt as it threshes at half the expense of bullocks.

Demonstration.

On account of farm conditions no large shows were attempted within my division. But two small shows were carried through in two tálukas of Ahmednagar and three public demonstrations were arranged for in Poona when cultivators from Sholapur and Nasik were sent by Revenue offices for instructions.

Besides, the five fieldmen have been in the district demonstrating the use of the iron-plough, groundnut, steeping, green manuring and Poona furnace throughout the year under the directions of the Divisional Inspector.

VII. DISTRIBUTION.

No inconsiderable part of the time of my staff has been employed in the distributions of seeds, implements and manure.

Thirty thousand lbs. of groundnut seed, 1,700 lbs. of cotton seed, 50,000 of sugar-cane sets and 3,800 lbs. of seeds of fodder crops.

The principal manure sent out was Sulphate of Ammonia for sugarcane which reached 6 tons. 272 ploughs were sold by the Department and 40 other implements. Many other scrapers and Planet Jr. hoes would have been disposed of if they had been obtained.

VIII. EDUCATION.

It must be borne in mind that in addition to the above work the three regular courses of the College—the Short Course and the farm Short Course in sugarcane work and Dairying—were carried on by the same staff; also numerous enquiries from cultivators have been answered.

J. B. KNIGHT, M.Sc.,
Professor of Agriculture.

Report of Dry Farming Agricultural Station, Ahmednagar, for the Year 1911-1912.

Situation.—The Ahmednagar temporary station is situated about 2 miles to the north-west of Ahmednagar in the centre of dry cultivation on the black soil area, of which jowár, wheat and gram are the staple crops. The land is taken up for a lease of 5 years, the total area being 15 acres.

Established 1909. North Latitude 19°-8″; East Longitude 17°-56″. Elevation 2,180 feet above sea-level. Distance from sea-coast 122 miles. Average rainfall 22′-69″. Temperature maximum 105° in May; and minimum 58° in December.

Statement below gives the rainfall at Nagar for the year under report :—

Rainfall for	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	Total.
The year 1911-12 ...	0	0·02	2·24	9·96	2·99	0·49	0·02	1·39	0·0	0·0	0·0	0·0	0·0	17·11
Total number of rainy days.	...	1	9	12	13	3	1	5	...	...	...	...	...	44

Season.—The anti-monsoon showers in April and May did not visit Nagar at all. The preparatory operations for the kharif crops were therefore delayed owing to the deep cracking of the deep black soil. The regular monsoon set in during the first week of June with a record of 1·25″ on the 4th. This was of some importance to the cultivators and the preparatory operations were commenced. These operations were further facilitated by frequent drizzlings during the month till 18th uptil which the record was 2·24″. Then followed a continuous drought for two weeks which brought the sowing operations to a stand-still. Owing to the failure of the anti-monsoon showers and the irregularity of the early rains the sowing of kharif crops especially cotton was delayed by 4 to 5 weeks. There was an unusually heavy downpour on the 6th of July the record being 5·95″ which was more than the soil could store and much was lost by surface drainage. The total rainfall during the month was 9·96″ which was more than half the total of the year. So far the rainfall was not unfavourable to the kharif crops but the anxiety was felt in September when there was an almost entire cessation in the rains till November. The kharif crops were harvested with very poor yields the consequence being the increase in the prices of food and fodder.

The season for Rabi crops opened very unfavourably with a zero rainfall in October which hampered and delayed all sowing operations. The remaining slight rainfall till the end of the season was not sufficient for the Rabi crops. This caused a partial famine.

It may be of interest to mention here that in a season when the late rains almost entirely failed the farm crops compared very flatteringly with those of surrounding cultivators. This was owing to the care bestowed upon tillage operations, both with regard to the preparatory cultivation before sowing and subsequent constant hoeings and inter-cultivation.

The cultivation experiments consisted of different methods of ploughing, sowing, intertillage and seed rates, etc., and are given in detail below :—

Experiment No. I.

Ploughing versus *no ploughing.*

Plot Number.	Crop.	Treatment.	Yield per acre.		Value of product.	Cost of cultivation.
			Grain.	Straw.		
					Rs. a. p.	Rs. a. p.
1	Jowár ...	No ploughing ...	303	1,217	41 4 1	9 13 8
2	Do. ...	Ploughing ...	342	1,228	42 14 8	15 11 3
A	Do. ...	No ploughing ...	248	832	29 10 5	7 14 0

The experiment was laid out with the object of investigating the effects of ploughing upon the crops. The usual practice among the cultivators in Nagar District is to harrow the land a few times.

The first plot was simply harrowed to prepare a good seed-bed and the second was ploughed by the CT2 plough supplemented by a few harrowings. To serve as a guide of the outturns which a careful cultivator may be expected to get from ordinary local methods of cultivation and also to serve as a comparison with our plots, a plot (A) was selected in a cultivator's field. From the figures given above, we see that although the ploughed plot has increased the yield by 13 per cent., yet it does not increase the net profits, owing to the extra expenditure of ploughing. Still the best way of ploughing and how often this is necessary are problems of later experiments, once we have proved its efficiency for storage of water.

EXPERIMENT No. 2.

Frequent versus *ordinary intertillage.*

Plot Number	Crop.	Treatment.	Yield per acre.		Value of product.	Cost of cultivation.
			Grain.	Kadbi.		
					Rs. a. p.	Rs. a. p.
3	Jowár ...	Well cultivated = 5 interculturings 18″ drill.	595	1,352	55 0 8	8 12 8
4	Do. ...	Ordinary cultivation = 2 interculturings, 18″ drill.	591	1,129	49 11 0	8 2 3
5	Do. ...	Ordinary cultivation = 2 interculturings, 9″ drill.	577	1,340	54 1 10	10 4 4

It will be seen from the above statement that the effect of frequent intertillage is marked. This was once more conspicuous during the period of growth than the results prove as in an extreme famine year, the larger plants may not be able to mature any more grain than the smaller ones. These plots can also be compared with (A) of first experiment.

Full seed rate versus *half seed rate.*

Plot Number.	Crop.	Tre tment.	Yield per acre.		Value of product.	Cost of cultivation.
			Grain.	Straw.		
					Rs. a. p.	Rs. a. p.
7	Jowár ...	Full seed rate, 18″ drill...	419	1,142	44 10 0	9 4 8
3	Do. ...	Half seed rate, 18″ drill...	595	1,352	55 0 8	8 12 8
1	Do. ..	Full seed rate, 9″ drill ...	303	1,217	41 4 1	9 13 8

This experiment was planned with the object of ascertaining whether the usual distance of 9″ with the ordinary seed rate was the most economical one. This was combined with an experiment of thinner seeding so much recommended by the Dry Farming Stations in America. From the above statement we see that Plot No. 1 which represents the usual practice, gives under the adverse conditions under report, 300 lbs. of grain and 1,200 lbs. of kadbi; while the 18″ drill gives over ⅓ increase in grain with slightly less fodder, but the still further reduction of the seed rate increased the yield to nearly double of the ordinary treatment. This result has been obtained for three years and we may lay it down as proved that thinner sowing in the dry tracts would bring increased yield of grain and kadbi; but the danger is that unless the seed has full powers of germination or if there is any loss from borers that there will not be sufficient stocks to utilize all the space. Moreover their seeding requires very careful sowing.

I therefore would recommend the use of the 18″ drill and full seed rate to be thinned when the crop is past danger from borers. Perhaps if some more accurate sowing implement is found we may even reduce the seed rate somewhat.

Experiment No. 4.

Foreign versus *Indigenous Implements.*

Iron plough is one of the most economical and useful foreign implement that can be recommended to the Deccan conditions. In the statement given below the ploughing with this as against the country plough is the differential treatment :—

Plot Number.	Crop.	Results per acre.			
		Foreign.		Indigenous.	
		Principal.	By-product.	Principal.	By-product.
8	Jowár	345	1,527	.....	.....
9	Do.	382	1,534	.....	.....
10	Do.	.....	.....	312	1,463
11	Do.	.....	.....	265	1,349

It will be seen that the iron plough has increased the outturn both in grain and in kadbi.

Experiment No. 5.

In many places of light rainfall it has been found profitable to fallow the land every other year and conserve the rainfall of two years for growing a single crop. This was tried and the results appear below :—

Plot Number.	Crop.	Treatment.	Yield per acre.		Value.	Cost of cultivation.
			Grain.	Kadbi.		
					Rs. a. p.	Rs. a. p.
6	Jowár ...	Fallow ...	770	1,708	69 15 10	11 13 4
1	Do. ...	Usual ...	303	1,217	41 4 1	9 13 8

So far as grain is concerned, the yearly average for the fallow would be 385 as against 303 but in the case of fodder there would be 850 as against 1,217. However the fallow plot was not so thickly seeded as the check plot which is to be regretted, for in this case the results might have shown in favour of fallowing.

Certainly in years of very scanty rainfall in good deep soil it would be better to fallow part than to waste seed and labour to produce a very small crop and exhaust the moisture; but a fallow to be effective must be kept clean with a good soil mulch throughout the year.

Manurial Experiments.

With the object of ascertaining whether the quick acting artificial manures could be substituted in whole for the farm yard manure on the staple dry-crop of jowár, experiments were conducted during the year under report.

The results obtained are not published because the influence of the season has rendered the outturn of the various plots not comparable one with another for want of sufficient moisture.

The highly manured plots have yielded badly in comparison with the non-manured and the farm yard manured plots. This must be due to the absence of late rains which is always felt more in land which has been manured. The cost of manure is however great to permit of any net profit being realised.

Association Plots.

Cultural Experiments.

Experiments were laid down for the year under report in which deep ploughing has been compared with shallow or ordinary ploughing on one hand and with harrowing alone on the other to ascertain which is the best preparation for dry-crop.

Gram was sown in these plots but the crop, being attacked when quite young by what is called *kharpudi* was a total failure. The results are therefore not worth publishing.

Varietal Experiments with Cotton.

Cotton is the most important crop under experimental investigation and in the year under report comparative trials of the several types of cotton were made. The results tabulated below show that the Varadi (Rozeum) types are much the most prolific yielders. These results indicate the large profits which can be secured from a crop of pure Roseum cotton in a favourable season.

Statement below summarizes the results obtained :—

Number of plot.	Name of variety.	Yield per acre.	
		Principal.	By-product.
9	Neglectum Rosea Cutchica	240	...
10	Neglectum Rosea	222	...
11	Neglectum Vera Malvensis	215	...
12	Neglectum Vera Kathiawarensis	215	...
13	Neglectum Vera	235	...
14	Sugar Jari	170	...
15	Roseum	415	...
16	Khándesh	305	...
17	Karkeli	255	...
18	Cambodia	240	...
19	Bhuri	225	...
20	Upland Georgian	165	...
21	Bazar Cotton	175	...

Experiments made off the station.

Vadála Plots.

Situation.—These plots were selected on Rev. Fairbank's estate at Vadála, 27 miles from Nagar.

In laying out the experiments here, the object was two-fold—manure and cotton varieties.

Manurial Experiments.

With the object of ascertaining whether quick acting artificial manures could be substituted for farm yard manure, the following experiments were tried with cotton :—

The statement below gives the results :—

Number of plots.	Manure.	Quantity in lbs. per acre.	Yield per acre (principal product).
1	Potassium Sulphate	192	113
2	Superphosphate	500	151
3	Ammonium Sulphate	500	229
4	Potassium Sulphate and Superphosphate	192 500	117
5	Sulphate Potash and Sulphate Ammonia	192 500	172
6	Superphosphate and Sulphate Ammonia	500 500	262
7	K. + P. + N.	192+500+500	238
8	No Manure	.....	111

From the above statement, it appears that Ammonium Sulphate both singly and in combination has given much the best results.

Manurial Experiments with Sugarcane.

Sugarcane is grown on quite large scale under well irrigation in Nagar District and it is probable that the area under this crop will largely extend when the Ozar and Pravara Canals are opened.

The only manure at present in use is farm yard manure and this is already getting both scarce and dear. For these reasons it was suggested that manurial experiments in cultivators' fields with a view of demonstrating to the cultivators the beneficial results obtained at Mánjri Farm by means of commercial manure, be tried on a small scale.

Statement below shows the details of the manurial experiments :—

Plot number.	Manure given as a top dressing after farm yard manure.	Cost of manure.	Yield of gul per acre.				
			Yield.	Increase.	Value of increased yield.	Profit.	Loss.
		Rs. a. p.	Lbs.	Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Ammonium Sulphate+Cake ...	41 0 0	5,248	644	64 6 4	23 6 0	...
2	Ammonium Sulphate ...	40 0 0	4,648	44	4 6 4	...	35 9 8
3	Safflower Cake ...	42 0 0	4,820	116	11 9 7	...	30 6 5
4	Nothing ...	25 0 0	4,604	...	...	...	...

From the result statement of the manure experiments, it will be seen that Plot No. 1, which received a top-dressing of Sulphate of Ammonia and safflower cake improved in yield than either of the manures alone.

Varietal Experiments with Cotton.

The statement below gives the results which corroborate those at Nagar Farm :—

Number of plot.	Name of variety.	Principal outturn per acre in lbs.	Remarks.
11	Neglectum Rosea Cutchica	88	The yields are too low owing to the unfavourable season.
12	Neglectum Rosea	68	
13	Neglectum Vera	58	
14	Neglectum Vera Kathiawarensis	160	
15	Local seed	94	
16	Cambodia	34	
17	Buri	31	
18	Naked—American	9¼	
19	Sugar Jari	60	
20	Roseum	134	

Outturn Statement for the Crops of the Nagar Experiments for 1911-12.

No. of plot	Name of crop.	Area.	Outturn per plot.						Outturn per acre.						
			Grain in lbs.	By-product in lbs.	Value of Grain.	Value of By-Product.	Total.	Cost of Cultivation.	Grain in lbs.	By-Product in lbs.	Value of Grain.	Value of By-Product.	Total.	Cost of Cultivation.	Net Gain or Loss.
		A. g.			Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.			Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Jowâr ...	0 34	258	1,035	9 3 4	25 14 0	35 1 4	8 8 1	303	1,217	10 13 1	30 7 0	41 4 1	9 13 8	+31 6 5
2	Do. ...	0 34	294	1,044	10 6 3	26 1 6	36 7 9	13 5 7	342	1,228	12 3 5	30 11 3	42 14 8	15 11 2	+27 3 6
3	Do. ...	0 34	506	1,149	18 1 1	28 6 2	46 7 3	7 7 7	595	1,352	21 4 0	33 12 8	55 0 8	8 12 8	+46 4 0
4	Do. ...	0 34	503	972	17 15 4	24 14 9	42 4 1	6 14 9	591	1,129	21 1 8	28 9 4	49 11 0	8 2 3	+41 8 9
5*	Do. ...	0 16	231	536	8 3 11	13 6 4	21 10 3	4 1 9	577	1,340	20 10 0	33 7 10	54 1 10	10 4 4	+43 13 6
6†	Do. ...	0 16	308	683	11 0 0	17 1 2	28 1 2	4 11 9	770	1,708	27 7 11	42 7 11	69 15 10	11 13 4	+58 2 6
7	Do. ...	0 24·8	262	704	9 5 8	17 9 7	26 15 3	5 12 2	419	1,142	15 2 0	29 8 0	44 10 0	9 4 8	+35 5 4
8	Do. ...	1 9	423	1,871	15 1 8	46 12 5	61 14 1	13 11 2	345	1,527	12 5 1	38 2 11	50 7 0	11 2 2	+39 4 10
9	Do. ...	1 9	468	1,889	16 11 5	47 0 0	63 11 5	13 6 2	382	1,534	13 10 3	38 5 10	52 0 1	10 14 9	+41 1 4
10	Do. ...	1 9	383	1,792	13 10 10	44 12 9	58 7 7	11 13 2	312	1,463	11 2 3	36 9 1	47 11 4	9 10 5	+38 0 11
11	Do. ...	1 9	200	1,665	10 11 5	41 10 0	52 5 5	11 6 11	265	1,349	9 1 8	33 15 8	43 1 4	9 5 3	+33 12 1
12	Do. ...	0 10	78	315	2 12 6	6 14 0	9 10 6	10 10 9	312	1,260	11 2 3	31 8 0	42 10 3	42 11 0	— 0 0 9
13	Do. ...	0 10	66	311	2 5 8	7 12 5	10 2 1	17 9 11	264	1,244	9 1 1	31 1 7	40 2 8	70 7 9	—30 5 1
14	Do. ...	0 10	65	334	2 5 1	8 5 7	10 10 8	26 5 0	260	1,336	8 14 10	33 6 4	42 5 2	105 4 0	—62 10 10
15	Do. ...	0 10	72	338	2 9 1	8 7 2	11 0 3	32 14 9	288	1,352	10 4 6	33 12 9	44 1 3	131 11 4	—87 9 9
16	Do. ...	0 10	68	271	2 6 10	6 12 5	9 3 3	4 13 9	272	1,084	9 11 5	27 1 7	36 13 0	19 7 0	+17 6 0
17	Do. ...	0 10	46	256	1 10 3	6 6 5	8 0 8	6 0 2	184	1,024	6 9 1	25 9 7	32 2 8	4 0 8	+ 8 2 0
18	Do. ...	0 10	48	244	1 11 5	6 1 7	7 13 0	12 2 2	192	976	6 13 8	24 6 4	31 4 0	48 8 8	—17 4 8
19	Do. ...	0 10	34	231	1 3 5	5 12 5	6 15 10	27 7 2	132	924	4 11 5	23 1 7	27 13 0	109 12 8	—81 15 8
20	Do. ...	0 10	38	181	1 5 8	4 8 5	5 14 1	20 4 0	144	724	5 2 3	18 1 7	23 3 10	81 0 0	—57 12 2
*5	Bâjri ...	0 8	15	75 bundles.	0 9 7	1 2 0	1 11 7	1 10 3	75	480	3 0 0	5 10 0	8 10 0	8 3 3	+ 0 6 9
†6	Do. ...	0 8	65	155 bundles.	2 9 7	2 5 2	4 14 9	1 11 3	325	1,115	13 0 0	11 10 0	24 10 0	8 8 3	+16 1 9
	Irregular Jowâr ...	1 20	425	1,513	15 2 10	37 13 2	53 0 0	14 11 4	283	1,008	10 1 8	23 3 5	33 5 1	9 12 10	+23 8 3

Outturn statement of the Rabi crops of the association plots for the year 1911-1912.

Number of plot.	Name of Crop.	Area.	Per plot.						Per acre.							Remarks.
			Grain in lbs.	By-Product in lbs.	Value of grain.	Value of By-Product.	Total.	Cost of cultivation.	Grain in lbs.	By-Product in lbs.	Value of grain.	Value of By-Product.	Total.	Cost of cultivation.	Net gain or loss.	
		A. g.	Lbs.	Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Lbs.	Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
1	Grain	0 36	145	139	5 12 9	1 6 2	7 2 11	13 15 1	161	154	6 7 0	1 8 7	7 15 7	15 7 11	−7 8 4	
2	Do.	0 36	152	130	6 1 3	1 4 9	7 6 0	14 3 7	168	141	6 11 6	1 7 0	8 2 6	15 12 10	−7 10 4	
3	Do.	0 36	101	106	4 0 6	1 0 11	5 1 5	8 10 4	112	117	4 7 8	1 2 8	5 10 4	9 9 8	−3 15 4	
4	Do.	0 36	136	119	5 7 0	1 3 0	6 10 0	10 13 4	151	132	6 0 7	1 5 1	7 5 8	12 0 7	−4 10 11	
5	Do.	0 36	164	131	6 8 11	1 4 11	7 13 10	13 6 6	182	145	7 4 5	1 7 2	8 11 7	14 14 4	−6 2 9	
6	Do.	0 36	151	122	6 0 6	1 0 9	7 1 3	13 15 8	167	135	6 10 10	1 5 7	8 0 5	15 8 6	−7 8 1	
7	Do.	0 36	165	127	6 9 7	1 5 11	7 15 6	10 4 2	183	151	7 5 1	1 8 1	8 13 2	11 6 5	−2 9 3	
8	Do.	0 36	84	92	3 5 9	0 14 8	4 4 5	8 11 1	93	102	3 11 6	1 0 2	4 11 8	9 10 6	−4 14 10	
	Irregular plot grain ...	0 7	12 / 1,110	3 / 977	0 7 8	0 0 5	0 8 1	...	...	...	...	...	...	...	...	
			Cotton lbs.						Cotton Lbs.							
9	N. R. C.	0 8	48	...	4 6 4	...	4 6 4	4 3 3	240	...	22 0 0	...	22 0 0	21 0 3	+0 15 9	
10	N. R.	0 8	44	...	4 1 3	...	4 1 3	4 1 3	222	...	20 5 7	...	20 5 7	20 6 3	−0 0 8	
11	N. V. M.	0 8	43	...	3 15 0	...	3 15 0	4 1 3	215	...	19 11 4	...	19 11 4	20 6 3	−0 10 11	
12	N. V. K.	0 8	43	...	3 15 0	...	3 15 0	4 7 3	215	...	19 11 4	...	19 11 4	22 4 3	−2 8 11	
13	N. V.	0 8	47	...	4 4 11	...	4 4 11	4 13 9	235	...	21 8 8	...	21 8 8	24 4 9	−2 12 1	
14	Sagar Javi	0 8	34	...	3 1 10	...	3 1 10	4 4 7	170	...	15 9 4	...	15 9 4	21 6 11	−5 13 7	
15	Rosiem	0 8	83	...	7 9 8	...	7 9 8	4 13 0	415	...	38 0 8	...	38 0 8	24 1 2	+13 5 6	
16	Khandesh	0 8	61	...	5 9 5	...	5 9 5	4 6 0	305	...	27 15 4	...	27 15 4	21 14 2	+6 1 2	
17	Kurkeli	0 8	51	...	4 10 9	...	4 10 9	4 0 0	255	...	23 6 0	...	23 6 0	20 5 5	+3 0 7	
18	Cambodia	0 8	48	...	4 6 4	...	4 6 4	4 6 2	240	...	22 0 0	...	22 0 0	21 12 5	+0 3 7	
19	Bhuri	0 8	45	...	4 2 0	...	4 2 0	3 3 3	225	...	20 10 0	...	20 10 0	16 0 5	+4 9 7	
20	Upland Georgian ...	0 8	33	...	3 0 4	...	3 0 4	2 6 7	165	...	15 2 0	...	15 2 0	12 0 11	+3 1 1	
21	Bazar Cotton ...	0 8	35	...	3 3 4	...	3 3 4	3 7 6	175	...	16 0 8	...	16 0 8	17 5 5	−1 4 9	

Statement showing the Outturn, Value and Cost of cultivation of the Vadala Cotton Experimental Plots for the year 1911-12.

Plot No.	Name of Cotton Variety.	Area. A. g.	Kind of Manure.	Per plot. Outturn. Yield.	Per plot. Outturn. Value.	Per plot. Cost of cultivation.	Per acre. Outturn. Yield.	Per acre. Outturn. Value.	Per acre. Cost of cultivation.	Net Profit or Loss.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12
				Lbs.	Rs. a. p.	Rs. a. p.	Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
1	Selected Varadi cotton.	0 10	K.	28¼	2 5 8	11 6 6	113	9 6 8	45 10 0	−36 3 4	Rainfall, 1911.
2	Do. ...	0 10	P.	37¾	3 2 4	18 0 4	151	12 9 4	72 1 4	−59 8 0	In ct.
3	Do. ...	0 10	N.	57¼	4 12 4	18 8 3	229	19 1 4	74 1 0	−54 15 8	June ... 4·43
4	Do. ...	0 10	K. + P.	29¼	2 7 0	23 15 2	117	9 12 0	91 12 8	−82 0 8	July ... 3·40
5	Do. ...	0 10	K. + N.	43	3 9 4	23 0 9	172	14 3 4	92 3 0	−77 15 8	August ... 2·01
6	Do. ...	0 10	P. + N.	65½	5 7 4	32 1 5	262	21 13 4	128 5 8	−106 8 4	September ... 0·24
7	Do. ...	0 10	K. + P. + N. ...	59¼	4 15 4	36 4 8	238	19 13 4	145 2 8	−125 5 4	October ... 0·60
8	Do. ...	0 10	No Manure	23¾	2 5 0	5 3 6	111	9 4 0	20 14 0	−11 10 0	November ... 1·32
9	Do. ...	0 10	Intertillage	37	3 1 4	5 2 8	148	12 5 4	20 10 8	−8 5 4	Total ... 11·40
10	Do. ...	0 10	No Intertillage ...	46¾	3 14 4	4 3 4	187	15 9 4	16 13 4	−1 4 0	
11	N. R. C. ...	0 10	No Manure local system.	22	1 13 4	5 13 6	88	7 5 4	23 6 0	−16 0 8	
12	N. R. ...	0 10	Do. ...	17	1 6 8	6 4 0	68	5 10 8	25 0 0	−19 5 4	
13	N. V. ...	0 10	Do. ...	14½	1 3 4	6 5 1	58	4 13 4	25 4 4	−20 7 0	
14	N. V. K. ...	0 10	Do. ...	40	3 5 4	6 3 0	160	13 5 4	24 12 0	−11 6 8	
15	Local (Nagar District).	0 10	Do. ...	23½	1 15 4	6 0 4	94	7 13 4	24 1 4	−16 4 0	
16	Cambodia ...	0 10	Do. ...	8½	0 11 4	4 13 4	34	2 13 4	19 5 0	−16 7 8	
17	Buri ...	0 10	Do. ...	7¾	0 10 4	5 6 10	31	2 9 4	21 11 4	−19 2 0	
18	Nalud American ...	0 10	Do. ...	2$\frac{5}{16}$	0 3 1	5 4 0	9¼	0 12 4	21 0 0	−20 3 8	
19	Sagar Jari ...	0 10	Do. ...	15	1 4 0	5 12 7	60	5 0 0	23 2 4	−18 2 4	
20	Rosiem ...	0 10	Do. ...	34	2 13 4	6 2 3	134	11 5 4	24 9 0	−13 3 8	
	Total ...			612·9	51 6 1	234 15 6		255 6 4	630 13 8		

Plot No. 1.—Statement showing the result of sugarcane experiments at Vaddla Farm, the manure applied Ammonium Sulphate with Safflower cake.

Date.	No. of adhan per day.	No. in lbs. sugarcane per adhan.	Juice per adhan.	Gul per adhan.	Kinds of fuel.	Time for mill per adhan.	Time for pan per adhan.	No. in lbs. sugarcane.	Gul per day.	Remarks.
1	2	3	4	5	6	7	8	9	10	11
		Lbs.	Lbs.	Lbs.	Stalks of chillies.			Lbs.	Lbs.	
8th February 1912 ...	1	1,332	812	147	561 lbs.	P. M. P. M. 1 20 to 2 0 2 23 to 3 30	P. M. P. M. 3 45 to 5 30	1,332	147	
9th February 1912 ...	2	1,238	812	147	Stalks of chillies. 600 lbs.	A. M. A. M. 9 0 to 11 30	P. M. P. M. 12 0 to 2 30	...	...	
.....	...	1,217	812	145	Stalks of chillies. 589 lbs.	P. M. P. M. 2 0 to 4 30	P. M. P. M. 5 0 to 7 30	2,495	292	
10th February 1912 ..	3	1,219	891	147	Stalks of chillies 600 lbs.	A. M. A. M. 5 55 to 6 55 7 0 to 8 0	A. M. A. M. 8 10 to 11 45	...	...	
.....	...	1,161	812	143	Stalks of babhul.	A. M. A. M. 10 30 to 11 25 A. M. P. M 11 40 to 12 34	P. M. P M. 12 45 to 3 0	...	...	
.....	...	1,207	812	147	.....	P. M. P. M. 12 52 to 1 40 1 52 to 2 50	P. M. P M. 3 35 to 5 30	3,687	437	
11th February 1912 .	3	1,290	891	147	.....	A. M. A. M. 4 45 to 5 35 5 45 to 6 40	A. M. A. M. 7 0 to 9 10	...	...	
.....	...	1,253	891	146	.....	A. M A. M. 10 10 to 11 5 A. M. P. M. 11 15 to 12 10	P. M. P. M. 12 30 to 2 45	...	...	
.....	...	1,103	812	143	.....	P. M. P. M 2 15 to 3 10 3 25 to 4 30	P. M. P. M. 5 0 to 7 15	3,647	436	
								11,051	1,312	

Plot No 2.—Statement showing the result of sugarcane experiments at Vaddla Farm, the manure applied Safflower cake only.

Date.	No. of adhan per day.	No. in lbs. sugarcane per adhan.	Juice per adhan.	Gul per adhan.	Kinds of fuel.	Time for mill per adhan.	Time for pan per adhan.	Sugarcane in lbs. per day.	Gul per day.	Remarks.
1	2	3	4	5	6	7	8	9	10	11
		Lbs.	Lbs.	Lbs.		A. M. A. M.	A. M. A. M.	Lbs.	Lbs.	
12th February 1912 ...	2	1,463	1,168	160	Stalks of Babhul.	4 0 to 5 0 5 10 to 7 10	6 30 to 8 45	...	...	
.....	...	1,649	1,188	169	.....	A. M. P. M. 11 0 to 12 5 P. M. P. M 5 25 to 8 0	P. M. P. M. 3 15 to 6 0	3,112	329	
13th February 1912 ...	2	1,592	1,183	158	Magas. 689 lbs.	A. M. A. M. 4 0 to 5 0 5 15 to 6 20 6 25 to 7 10	A. M. A. M. 7 20 to 10 10	...	...	
.....	...	1,489	1,198	158	Magas.	A. M. A. M. 10 0 to 11 0 noon 11 0 to 12 0 P. M. P. M. 12 5 to 1 15	P. M. P. M. 2 0 to 5 0	3,081	316	
14th February 1912 ...	4	1,271	891	140	.....	A. M. A. M. 4 30 to 6 30	A. M. A. M. 6 45 to 8 50	...	...	
.....	...	1,302	891	142	.....	A. M. A. M. 8 0 to 10 0	A. M. P. M. 11 0 to 1 0	...	...	
.....	...	1,290	891	141	.....	P. M. P. M. 1 0 to 3 0	P. M. P. M. 3 15 to 5 30	...	...	
.....	...	1,281	891	137	Pachat.	P. M. P. M. 4 0 to 6 15	P. M. P. M. 6 30 to 7 0	5,144	568	
								11,337	1,205	

Plot No. 3.—Statement showing the result of sugarcane experiments at Vaddla Farm, the manure applied Ammonium Sulphate only.

Date.	No. of adhan per day.	No. in lbs. sugarcane per adhan.	Juice per adhan.	Gul per adhan.	Kind of fuel.	Time for mill per adhan.	Time for pan per adhan.	No. in lbs. sugarcane per day.	Gul per day.	Remarks.
1	2	3	4	5	6	7	8	9	10	11
		Lbs.	Lbs.	Lbs.						
15th February 1912 ...	3	1,444	891	147	Magas.	A. M. A. M. 5 0 to 7 0	A. M. A. M. 7 15 to 10 0	...	...	
.....	...	1,397	...	146	.....	A. M. A. M. 8 0 to 10 15	A. M. P. M. 10 30 to 12 45	...	...	
.....	...	1,386	...	142	Pachat.	P. M. P. M. 2 0 to 4 15	P M. P. M. 4 30 to 6 30	4,229	435	
16th February 1912 ...	3	1,352	...	142	.....	A. M. A. M. 4 30 to 6 45	A. M. A. M. 7 0 to 9 15	...	...	
.....	...	1,290	...	143	Magas.	A. M. A. M. 8 0 to 10 15	A. M. P. M. 10 30 to 1 0	...	...	
.....	...	1,299	...	142	.....	P. M. P. M. 2 0 to 4 15	P. M. P. M. 4 30 to 6 45	3,841	427	
17th February 1912 ...	2	1,320	...	147	Pachat.	A M. A. M. 4 30 to 6 45	A. M. A. M. 7 0 to 9 30	...	...	
.....	...	1,664	1,188	158	.....	A. M. A. M. 8 0 to 11 0	A. M. P. M. 11 30 to 2 0	2,984	305	
								11,054	1,167	

Plot No. 4.— Statement showing the result of sugarcane experiments at Vaddla Farm, no manure.

Date.	No. of adhan per day.	No. in lbs. sugarcane per adhan.	Juice per adhan.	Gul per adhan.	Kind of fuel per adhan.	Time for mill per adhan.	Time for pan per adhan.	Sugar-cane per day.	Gul per day.	Remarks.
1	2	3	4	5	6	7	8	9	10	11
		Lbs.	Lbs.	Lbs.						
17th February 1912 ...	1	1,420	891	147	Magas.	P. M. P. M. 2 0 to 4 0	P. M. P. M. 4 15 to 6 30	1,420	147	
18th February 1912 ...	4	1,422	891	149	Pachat.	A. M. A. M. 5 0 to 7 0	A. M. A. M. 7 15 to 9 40	...	...	
.....	...	1,349	891	149	Pachat.	A. M. A. M. 7 15 to 9 40	A. M. A. M. 9 55 to 12 0	...	...	
.....	...	1,402	891	148	Magas.	P. M. P. M. 1 0 to 3 0	P. M. P. M. 3 15 to 5 25	...	...	
.....	...	1,389	891	146	.....	P. M. P. M. 3 15 to 5 35	P. M. P. M. 5 45 to 8 10	5,502	592	
19th February 1912 ...	2	1,215	891	140	.....	A. M. A. M. 5 0 to 7 15	A. M. A. M. 7 30 to 9 30	...	...	
.....	...	1,283	891	142	Pachat.	A. M. A. M. 8 30 to 10 55	A. M. P. M. 11 10 to 1 25	2,503	282	
20th February 1912 ...	1	1,239	812	130	.....	A. M. A. M. 5 0 to 7 0	A. M. A. M. 7 15 to 9 30	1,239	130	
								10,724	1,151	

EXPERIMENTS CARRIED OUT BY THE DIVISIONAL INSPECTOR OF AGRICULTURE, C. D.

Experiment I.

Cotton Varieties at Tásgaon.

To see whether Broach may, with advantage, replace local types and whether Cambodia and Bhuri are better than Broach for Sátára District, cotton was tried at Tásgaon in Sátára District. A field 1¾ acres was taken on lease and divided into two parts of 60 and 50 gunthas each. In the first plot seed was sown early as per local practice and in the other it was sown late (23rd August 1911) as per practice prevalent in Sholápur and Nagar Districts.

The results are tabulated below :—

Name of variety.	Area.	Seed.	Outturn per acre.		Remarks.
			Early sown.	Late sown.	
		Lbs.			
Local	10 gunthas each.	3	192	156	
Broach		3½	32	...	
Cambodia		2½	152	44	
Bhuri		3	176	72	
Karkheli		4	190	148	
Upland Georgian		3	19	Not sown.	

The rainfall for the year was insufficient but we may note from the table that the early sown plots have given better yield in every case.

The local variety is of the Herbaceum type but Broach is almost a failure. Only Karkheli, of the varieties tried, has approximated the local in point of yield. However Buri and Cambodia are sufficiently promising to warrant a repetition of the experiment under a decent rainfall.

Experiment II.

Cotton Varieties at Karmála.

To compare the yields of the varieties now grown in Sholápur, with each other and with Sagar Jari, experiments were carried out at Karmála.

The different types of Varadi cotton were tried at Karmála of Sholápur District but the famine conditions made the results of little value. The yellow-flowered narrow and roseum have done best. These experiments, which include a study of the cottons found in Sholápur and isolating the varieties and comparing them with those from outside, will be transferred to Bársi.

Details appear below :—

Variety.	Area.	Outturn per acre.	Remarks.
White-flowered, broad lobed ...	10 gunthas each.	88	
Do. narrow lobed ...		68	
Yellow-flowered, broad lobed ...		58	
Do. narrow lobed ..		160	
Local (Nagar)		94	
Cambodia		34	
Dhárwár-American		94	
Sagar Jari		60	
Roseum		136	
Buri		30	

Experiment III.

Manure Experiments with Cotton.

The manurial experiments were also very unsatisfactory in point of outturn, but Sulphate of Ammonia seems to have had some effect even in this dry year, also has Superphosphate and their combination has increased the yield 2½ times. Potash show no increase. Now comes the question of what quantity will pay.

Statement Showing the Results of Manurial Experiments.

No. of plots.	Manure applied.	Outturn per acre.
		Lbs.
1	Potassium Sulphate ...	113
2	Superphosphate ...	151
3	Ammonium Sulphate ...	229
4	Potassium Sulphate ... / Superphosphate ...	117
5	Potassium Sulphate ... / Ammonium Sulphate ...	172
6	Superphosphate ... / Ammonium Sulphate ...	262
7	Superphosphate ... / Ammonium Sulphate ... / Potasium Sulphate ...	238
8	No Manure ...	111

Experiment IV.

Manurial Experiments with Tobacco.

Manurial tobacco experiments were continued during the year under report at Kasegaon and Dudhegaon in Válva Táluka of the Sátára District to confirm the deductions of the last year.

In the following table the results of the manurial test of tobacco is tabulated :—

Plot No.	Area.	Kind of manure.	Quantity applied per acre.	Outturn per acre.	Remarks.
		Dudhegaon.	Lbs.	Lbs.	
I	10 gunthas	Ammonium Sulphate ... / Superphosphate ... / Potassium Sulphate ...	240 / 316 / 224	520	
II	,, ...	Gural Ashes .. / Safflower Cake ...	5,000 / 900	440	
III	,, ...	No Manure ...	...	400	
		Kasegaon.			
I	10 gunthas	Ammonium Sulphate ... / Superphosphate ... / Potassium Sulphate ...	240 / 316 / 224	1,040	
II	,, ...	Safflower Cake ... / Gural Ashes ...	900 / 5,000	1,144	
III	,, ...	Safflower Cake ... / Gural Ashes ...	450 / 2,500	1,144	
IV	,, ...	No Manure ...	...	1,040	

It will be seen from the above table that the plots at Kasegaon have given better yield than those at Dudhegaon. The fertilizers do not seem to be paying. Outturns of the manured plots are not as good as no manure plots. It is striking to observe that the combination of safflower cake and gural ashes have given more outturn than the combination of Superphosphate and Ammonium Sulphate.

Experiment V.

Manurial Experiments with Sugarcane.

In the year 1911-12, 16,400 lbs. of safflower cake and 14,044* lbs. of Ammonium Sulphate were distributed. The stock of manures purchased for distribution being limited, many requisitions were refused. The increasing demands for these manures and the quantities distributed this year will show that these manures have gained a firm footing in the Southern Marátha Country.

Being thus encouraged, these experiments were continued at Karanjawadi, Retre and Kasegaon in Sátára District and attempted at Lonarwadi, Sinnar, Bez, Malegaon and Chandanpuri in Násik District and at Náráyangaon in Junnar Táluka of Poona District. At the places mentioned above, sugarcane is grown on a large scale. A statement showing the results of these experiments is attached herewith. No results from one of the plots at Ráhuri and Náráyangaon could be shown in the said statement since the cane manure was sold by the growers to Bágwans before maturity of deficiency of water.

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* Statement of distribution of Ammonium Sulphate attached.

Statement showing the results of sugarcane manurial experiment in Sátára, Nagar and Násik Districts.

Serial No.	Name of place.	Plot No.	Application of manure per acre.	Yield per acre in lbs.	Value of outturn at 13½ lbs. per rupee.	Cost of manure applied per acre.	Profit.	Loss.	Remarks.
				Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.		
1	Karanjwáde ...	I	Farmyard manure 40 cart-loads, sheep folding 1,333 for 2 days at Rs. 5 per day.	9,765½	565 3 4	146 10 8	418 8 8	.....	When compared with expenses this has given poor outturn.
		II	Farmyard manure 20⅔ cart-loads. Ammonium Sulphate 380 lbs.	8,362⅔	619 7 4	97 5 4	520 2 0	.....	
		III	Farmyard manure 20⅔ cart-loads. Safflower cake 1,500 lbs.	8,512	630 8 2	98 13 4	531 10 10	.....	This combination is better than the above two.
		IV	Farmyard manure 20⅔ cart-loads. Ammonium Sulphate 190 lbs. Safflower cake 750 lbs.	11,136	824 14 2	98 13 4	726 0 10	.....	This has surpassed the above three combinations.
2	Vadála (Nagar) ...	I	Ammonium Sulphate 374½ lbs.	5,252	393 14 5	87 7 0	.....	.....	This has given better outturn than the following combinations of manures.
		II	Safflower cake 624 lbs. Ammonium Sulphate 187 lbs. at 10 lbs. per rupee.	4,820	361 8 0	34 4 9	.....	.....	This combination has given better outturn than the application of mere Safflower cake.
		III	Safflower cake 312 lbs. at 40 lbs. per rupee.	4,668	349 12 10	31 3 2	.....	.....	
		IV	Farmyard manure 40 cart-loads at Re. 1 per cart.	1,447	108 8 5	40 0 0	.....	.....	Very poor outturn though were expensive than any of the above treatments.
3	Retre Budruk ...	I	Farmyard manure 40 cart-loads. Karanja cake 2,000 lbs.	8,501	629 11 3	170 0 0	459 11 3	.....	
		II	Farmyard manure 40 cart-loads. Karanja cake 1,000 lbs. Ammonium Sulphate 250 lbs.	9,528	705 12 5	145 0 0 +25 0 0 = 170 0 0	535 12 5	.....	To say nothing of the cost, the combination of farmyard manure, Karanja cake and Ammonium Sulphate has given better yields than either of the combinations.
		III	Farmyard manure 40 cart-loads. Ammonium Sulphate 50 lbs.	7,359	545 1 9	175 0 0	375 1 9	.....	
		IV	No manure	6,088	450 15 5	.....	.....	.....	

Experiment 6.

Tag (Crotalaria Juncia) for rice.

Generally rice is taken in Konkan and Máwal in the same fields year after year without giving any manure. The nursery only is rabbed with loppings of trees. But it has now become difficult to get sufficient rab materials even for the nursery and this Department has been carrying on experiments in this connection for several years; and this experiment is just a supplement to the general efforts.

Ploughing tag for rice crop was experimented at Wadgaon in Máwal Táluka of Poona District.

Ploughing tag is not a new thing in India, but it is new as a preparation for the rice crop in Mawal and Konkan. We supplied the Tag-seed and when the crop was ready, we ploughed it in. Except this, all the work was done by the owner and so the experiments were inexpensive.

Tag was sown after a plough on 16th of June and was green manured on 30th of July. It was about 4½ feet high and should have weighed about 30,000 lbs. per acre (crop from a small area was weighed). Both the tag and the local system plots were given the same treatment.

To equalize the advantage of opening the land at the time of sowing and green manuring, the check plot was similarly ploughed at the same time. As the cultivators plough their paddy fields this does not add to the labour.

From the beginning the crop on the tag plot was more vigorous, taller and darker in colour. The plots were shown to few intelligent cultivators. The Director of Agriculture also once visited the plots. The cultivators liked the idea and seemed willing to try green manuring, if seed be supplied to them.

The following table gives the result of the experiment:—

Treatment given.	Paddy per acre.	Straw per acre.	Excess over local plot.	
			Paddy.	Straw.
	Lbs.	Lbs.	Lbs.	Lbs.
Green manured	1,634	1,960	1,131	627
Local system	503	1,333	...	...

It can easily be seen from this that ploughing Tag for rice crop has proved a very good preparation.

EXPERIMENT 7.

Poudrette was tried for Jirayat (dry) crops at Karmala and Poona. For want of rain the plots at Karmala were not successful; but some encouraging results could be seen at Poona. The fact that insufficient rainfall doubtless put manure plots at a greater disadvantage.

Kind of manure.	Quantity per acre, lbs.	Outturn of grain per acre, lbs.	Outturn of fodder per acre, lbs.	Remarks.
Poudrette	4,000	492	819	
Farm Yard	5,000	322	619	
No Manure	...	234	598	

From this we see that a small dressing of farm yard or poudrette manure to Jirayat crops given several months before, *i. e.*, just after the harvest of previous crop, is profitable and will surely pay the cultivator where it is available.

EXPERIMENT No. 8.

The double furnace was compared with the local furnace at Kolhápur.

The following table shows the time and fuel required for the double and Sátára furnaces comparatively.

Type of furnace.	Weight of juice.	Number of pan.	Weight of fuel.	Time.	Fuel required to boil out 1,000 lbs of juice.
Double	1,400	1st	441	3-2	288½
Do.	1,400	2nd	367	2-32	...
Sátára	1,400	1st	581	3-17	387
Do.	1,400	2nd	580	3-15	...

From the figures it will be seen that there is saving of ¼ of the fuel. Figures for Shevri fuel were also taken on both the furnaces (*see* the preceding table) for four successive pans and it was found that to boil 1,000 lbs. of juice on Sátára furnace 450 lbs. of fuel were required, while for the same amount of juice on the double furnace only 321 lbs. were quite sufficient.

In order to find out how much of the heat is utilized in the upper furnace concentration and temperature tests were taken.

The juice from the mill gave 16·61 corrected Brix; the temperature being 26·75 and after 3 hours heating in the storage pan the temperature had risen to 85°, while the Brix reading was 17·91.

The weight of juice per pan was 1,400 lbs. of 16·61 Brix. Taking 5 per cent. as the average moisture in Gul the quantity of Gul from 1,400 lbs. should come to $\frac{16{\cdot}61 \times 100}{95}$ = 17·4900 say 17·5 × 14 = 245 lbs. Therefore the remaining 1,155 lbs. of water ought to evaporate from 80°F. Now the total heat of steam required to evaporate one lb. of water from 80°F. is 118 B.T.U. Thus the whole heat of steam required is 1,155 × 1,118 = 1,291,190 B.T.U.

But from the tests it was found that 94·64 lbs. of water were actually evaporated, for which 94·64 × 1,118 = 1,05,807·5 B.T.U. were utilized; while to raise the temperature of 1,060·36 lbs. of water from 80°F. to 185°F. 111,337·8 B.T.U. were spent, thus the total heat gained is :—

111,337·8 − 105,807·5 = 217, 145·3 B.T.U. or about $\frac{1}{8}$ of the total heat of steam required to boil 1,400 lbs. of juice of 16·61 Brix.

Besides the saving of time and fuel other advantage from the Double Furnace is that there is very little chance of inversion in the juice from being exposed to air, for as soon as the juice receiving tank is full, it is emptied direct into the storage where the temperature after mixing goes to about 70°C.

The adaptation of Double Furnace will be very easy and inexpensive for Sátára cultivators, as they already possess a juice storage tank placed on a higher level with a pipe and a peg at the bottom to run the juice by gravity into the boiling pan.

The only thing necessary for them is to build the upper furnace for the storage tank, attached to it a chimney to pass over the smoke and the peg being replaced by a cast iron cock, the whole costing not more than Rs. 15.

The advantages of the Double Furnace may be summarised as follows :—

(I) Much time will be saved. They have to work for 18 to 19 hours per day on the local furnace, while on the Double Furnace only 14 to 15 hours will be sufficient.

(II) *Fuel.*—No extra fuel will at least have to be purchased. Thus a saving of Rs. 30 per acre.

(III) *Wages.*—The wages of the Jalwa can be reduced to 2 annas per boiling; thus a saving of annas 12 per day or Rs. 4 per acre.

(IV) *Quality of Gul.*—By putting the juice direct for heating less inversion takes place which will help in improving the quality of Gul.

(V) *Trouble.*—The men in the Gurahal will be more willing to work on Double Furnace as their number of hours of work per day are reduced by $\frac{1}{4}$.

(VI) Lastly they will have to use iron mills to supply the juice to Double Furnace which means an improvement in their system of crushing.

Triple Furnace.

Experiment 9.

This furnace was demonstrated by Mr. G. R. Mahajan, B.Ag., Graduate Fieldman, Manjri Farm, at Sholápur, on the estate of Mr. Hirachand Amichand Shaha, with success.

The following table shows the comparative results of this furnace with the local one :—

Triple Furnace.				Local Furnace.				Fuel required to boil 1,000 lbs. of Juice.		Time.	
Weight of Juice.	No of Pan.	Weight of Fuel.	Time.	Weight of Juice.	No. of Pan.	Weight of Fuel.	Time.	Triple.	Local.	Triple.	Local.
1,110	I	Trash. 516	3-30	603	I	258	2-35	346½	409	2-33	4-25
1,110	II	303	2-20	603	I	250	2-41	...	...	...	...
1,110	III	305	2-37	603	III	232	2-35	...	...	...	...

It is clear from the statement that there is saving of $\frac{1}{4}$ of the fuel and nearly half the time.

The furnace, as expected, has proved itself to be a complete success at Sholápur and it is as much appreciated by the Sholápur cultivators as the Double Furnace in Sátára District, and there is every hope that the old Sholápur Furnace will be replaced by the improved Triple Furnace within the scope of five years.

It has been found to be advantageous to cultivators in many ways.

(i) It reduces the expenses of building the series of furnaces only to ¼ which can be seen from the following figures :—

Expenses for building Sholápur Local Furnace.	Rs.	a.	p.	Expenses for building Triple Furnace.	Rs.	a.	p.
2 Brass of stones for ash pit at Rs. 30 per brass	60	0	0	5,000 bricks at Rs. 8 per 1,000 ...	40	0	0
5,000 bricks for an arch at Rs. 8 per 1,000	40	0	0	½ brass stones at Rs. 30 per brass ...	15	0	0
2,000 bricks for 4 furnaces	16	0	0				
1 brass stones for other walls	30	0	0	5 carts of white mud at Re. 1 each ...	5	0	0
25 carts of white mud	25	0	0				
Wages—				Wages—			
4 masons for one month at Re. 1 a day	120	0	0	2 annas for 8 days at Re. 1 a day ...	16	0	0
4 coolies to help them at Rs. 10 a month	40	0	0	3 coolies to help them for 8 days at 5 annas a day	8	0	0
Total ...	331	0	0	Total ...	84	0	0
or say ...	350	0	0	or say ...	90	0	0

By spending only ¼ the cultivator gets as strong a furnace as he uses to get by spending Rs. 350.

(ii) *Time* is saved to a large extent. They have to work for 16—18 hours on their furnace, while 12—14 hours are quite sufficient for the triple furnace.

(iii) *Trouble.*—There is thus less trouble to the labourers as they have to work for less number of hours on the same pay.

(iv) *Wages.*—There would be a saving of nearly 9 annas per day to the owner from this furnace. Four men are usually kept in Gurahal house for their furnaces, while this number can easily be reduced to 3.

The cultivator has to pay 4 Jalwas who boil 4 single pans every day at 0-6-0 per day, while on the triple furnace 2 Jalwas easily boil 8 pans and they are content with 0-10-0 each.

(v) *Fuel* saving is one of the important items. Owing to rain good trash or megass was not obtainable for trials, but from comparing the number of hours in one day they have to fire on this furnace we will get some idea.

To boil 16 single pans taking two hours for one pan they have to fire for $16 \times 2 = 32$ hours; while on the triple furnace to boil out 8 full pans 24 hours are more than sufficient. Now taking the rate of feeding is the same in every case, there is an obvious saving of ¼ of the fuel; or about 15 cart loads of trash per acre; *i. e.*, a saving of Rs. 30 per acre.

Letter from Mr. G. V. Dhavle of Retre Budruk who writes in his letter, dated 20th January 1912, as under :—

"I have controlled Double Furnace on my estate as demonstrated at Manjri in October last. Harvesting of cane has been commenced from the 13th instant. 326 lbs. of megass was required for each boiling of 1,353 lbs. of juice and the time required was 1·30 to 1·45 hours per boiling. This year I am using groundnut husk as fuel instead of trash and megass. The results will be sent to you in due course. To be brief, I find this Double Furnace will soon put down the Poona Furnace in our tract at least."

The saving of fuel by Double Furnace is worth noticing when compared to Sátára and Poona Furnaces :—

No.	Name of urnace.	Weight of Juice.	Weight of Fuel.	Difference when compared with Double Furnace.	Remarks.
		Lbs.	Lbs.	Lbs.	
1	Double Furnace	1,000	277	.....	
2	Poona Furnace	1,000	340½	63½	
3	Sátára Furnace	1,000	439	162	

(Signed) GOVIND VASUDEO DHAVLE.

Letter from Mr. Pandurang Anandrao Mohite of Retre Budruk who writes in his letter dated 15th March 1912, as under :—

"I had planted this year 4½ acres of sugarcane, and worked this completely on the Double Furnace. The season lasted for 27 days. I took 6 boilings each day. The outturn of Gul amounted to 37,050 lbs. I, at the commencement, had purchased 12 cartloads of groundnut husk. I boiled my juice on husk and megass and trash. To say nothing of husk, it is clear that I have saved at least one cartload of trash and megass. On the whole I find that this furnace has got a greater advantage over Sátára and even the Poona Furnace."

(Signed) PANDURANG ANANDRAO MOHITE.

Mr. Hirachand Nemichand Shaha of Sholápur, on whose estate the principle furnace was demonstrated, summarises the advantages derived from building the triple furnace in his letter dated the 24th December 1911 :—

"Last year I had planted in my fields about 12 acres of cane. I had a great desire to use improved methods of crushing and boiling my cane. I accordingly deputed my manager of the Manikbag estate to attend the demonstrations of improved furnaces held on the Manjri Farm in October last. Both the triple and Double Furnaces demonstrated there were found very useful and advantageous. I accordingly constructed triple furnace on my estate with the help of Mr. G. R. Mahajan and I am very glad to write to you that this furnace has greatly benefitted me in the following way :

(i) The total expenses for building this furnace in pucca bricks amounted to Rs. 100 only, while to build Sholápur Furnaces the expense goes to Rs. 300 to 350.

(ii) We boil 8 full pans per day in 12-13 hours, while to boil the same amount of juice on Sholápur Furnaces 17-18 hours are necessary. The fuel required for this is nearly half of that consumed by the Sholápur Furnaces.

(iii) We have made Gul moulds of galvanized iron by the use of which we get about 22 lbs. of treacle which is always lost in the pits dug in the ground by the cultivators.

(iv) The Gul obtained on this furnace is very fine in texture and colour and it has been approved of in the open market of Sholápur.

To be brief, the neighbouring cultivators like both the improved furnaces and the buckets and some of them have actually prepared the buckets."

(Signed) HIRACHAND AMICHAND.

As mentioned in my administrative reports of the preceding year, four prizes were awarded to the cultivators in Válva Táluka of Sátára District for showing economy in fuel in a small Durbar specially held at Kasegaon under the auspices of the Collector of Sátára, as below :—

1. G. V. Deshmukh Patangrao, Esq., Chikurda, a silver medal of Rs. 25 and a certificate.
2. Pandurang Anandrao Mohite of Retre Budruk, a silver medal of Rs. 20 and a certificate.
3. Govind Vasudeo Dhavle of Retre Budruk, a silver medal of Rs. 16 and a certificate.
4. Vinayak Gopal Kulkarni of Chikurda, Rs. 15 cash.
5. Balwantrao Diwan of Mangle, Rs. 10 in cash.

APPENDIX F.

SUMMARY OF EXPERIMENTAL WORK DONE UNDER THE ECONOMIC BOTANIST FOR 1911-12.

GANESHKHIND BOTANICAL GARDEN.

The season was marked by a most unsatisfactory rainfall. Extensive experiments on mangoes were carried out. Tongue grafting has proved more successful than whip grafting in this garden. Crown grafting has proved an eminently successful method of renovating older trees. Many buddings of mango were made, of which one was exceedingly successful and is now growing strongly. This successful one was made in November by the method known as shield budding on a stock in the field. This is believed to be the first successful budding of the mango in the Bombay Presidency. Several new varieties of mangoes were collected and planted. Manuring of young grafted trees with safflower cake proved the most satisfactory method of stimulating trees that halted in their growth. Complete pruning in October induced vigorous vegetative growths in December and following months. No conclusive results were got from salt manuring. Study of the malformation of the mango inflorescence showed that it was more virulent in certain zones and possibly on certain varieties. All grades of the abnormality may occur. No fungus or insect appears to be the cause, nor is there internal hypertrophy of actively growing tissues. The subject is being pursued. The mango crop was abnormally low in the garden and also in the district. Crossing has still been unsuccessful. Resting the mango trees in the manner in which oranges are rested did not produce any appreciable acceleration of the flowering season. Mango scions were successfully sent alive to Egypt in special packing. A packing experiment was again made with the result that the most satisfactory form of package for mango fruits in transit on the railway and road is a basket if it can be made thief-proof. The fruits should be wrapped in tissue paper to preserve their colour.

In work on Citrus varieties (oranges, lemons, etc.) another set of orange plants budded on Jamburi stock were planted. Budding on Reshami stock is not so reliable as budding on Mahalung or Jamburi. As to previously made buddings pomelo scions and limes on Mahalung stock are excellent and some others good. The oranges as a whole however do not do well on this stock. Jamburi is the most generally useful stock. Cross pollination between citrus varieties was finally unsuccessful though fruits formed.

In Papayas experiments again proved that fruits can set without the stimulus of pollen, but all fruits so formed dropped. Hermaphrodite papayas were largely in the majority. The time when papaya seeds germinate most quickly and in greatest percentage is in the rains. Seeds sown in the cold weather, though watered often, remain dormant till the rains, retaining their vitality but refusing to germinate. Ceylon Papayas were grown and compared with the local varieties. Their fruit is lucious and more piquant than the local one, the flavour moderate and pleasant, consistency that of a well boiled potato with considerably more water.

Guava plants from various sources are being raised to test their value. The tying down of guava branches does seem to increase the amount of fruits formed. The repeated layerings are still being carried out to test the belief regarding the production of seedlessness by this method. Crossings were unsuccessful between flowers of white and rosy guava plants.

The experimental treatment of grape vine mildew in Ganeshkhind, Mundwa and Násik resulted in the sprayed plants have only 9·7 percentage of attacked bunches, while unsprayed plants had 68·8 per cent. Five sprayings of Bordeaux mixture + soap per annum are now recommended: in May, August, October, December and January, the two last being half normal strength. New plantations of local varieties of vine have been made in the garden for studying these varieties and their treatment.

Among irrigated hedge plants Bábul (Acacia arabica) properly pruned has so far proved the best and Devbabul (Acacia farnesiana) among the unirrigated.

Treatment of crotons with repeated small doses of salt had the effect of slightly increasing their vigour and brilliancy.

Observations on pomegranates lead to the conclusion that these plants yield better in shallow soil than in black soil of 4½ feet deep. Lucerne did not prove very successful as an intercrop, becoming yellow and attacked by insects. Grassing down has so far not interfered with the health of the trees.

Cotton plants which suffered from last year's frost when properly pruned yielded quite good crops this year.

Plantains proved an unsatisfactory shade plant for coffee, but in the shade of the rain-tree Pithecolobium saman the coffee plants grew well.

Oporto onions were tried, both bulbs and seeds. The bulbs failed to produce flowering shoots; a mite also affected the bulbs. Seed gave bulbs of a size superior to local ones but not up to the size of bulbs grown in Oporto. Hot weather sowing was adverse to satisfactory germination. Seedlings raised from hot weather sowings gave long stem-like bulbs. Imported bulbs planted in January produced stem-like bulbs. It is recommended that seed should be introduced in September or October.

Proper pruning, manuring and culture of custard apples (Sitaphal) Anona squamosa produced a largely increased crop.

Close observations were made as to growth and power of propagation of the wild grasses and other plants suitable for fodder. These experiments are being continued this year when it is hoped to be able to recommend wild plants for dry waste lands.

Experiments were made to determine the value of smoky fires in warding off frost attack from fruit plantations. The fires were made of litter, cowdung and tar. These heaps were banked with earth and lit by kerosene. A difference of two degrees was registered between the thermometers outside and inside the treated area.

Bassein Botanical Garden.

Three new varieties of plantains from Africa were introduced. The results of last year's experiments on plantains have not yet been obtained. One Castilloa rubber tree yielded, when tapped, half an ounce of raw rubber which, on analysis, proved to have 82·94 per cent. of pure rubber. The Castilloa trees continue in excellent condition. Whip-grafted mango plants have, on the whole, done better than inarched ones both planted last year. Experiments are being made to compare Alphonse mango seedlings planted direct into the ground with those planted in pots and then transferred to the field. Grafted plants of Ramphal (Anona reticulata) flowered before the seedlings of the same plant. Graftings have been made of Sitaphal (Anona squamosa) on Ramphal, of Ramphal on Sitaphal, and of Ramphal on Mamphal (Anona muricata) to test the reciprocal influence of stock and scion. Cocoa plants flowered twice during the cold weather, and are doing well. A crop of coffee was harvested in November 1911, but since then there has been no satisfactory flowering, though curious dwarfed flowers appeared in March 1912. Eri silk and lac culture have proved failures on account of disease and insect pests.

Other Work.

In addition to the work done in the two botanical gardens, experimental treatment of grape vine mildew at Násik and Mundwa was carried out. The treatment was eminently successful and all that now remains to be done is to induce grape growers to take up the method on a large scale. At Alibág a large collection of rice varieties has been grown and is being examined with a view to classifying the many kinds of this important crop. Public lectures and advice have been given at many places in the Presidency. A special study of the morphology and anatomy of the Pan plant has been made by the Assistant Professor of Botany, and the Assistant Professor of Mycology and the Assistant Mycologist have been with success carrying out experiments in the spraying of the Supari palm against the dreaded Koleroga disease. This work is being done in Sirsi and Siddapur. Studies have been made and one paper written on some abnormalities in plant structure. The Assistant Professor of Botany has also been engaged in the introduction of the water chestnut, Trapa natans, into tanks and reservoirs. In mycological work descriptions of the life history of the new fungus Cystopsora oleæ and of the Castor rust have been made, and several new fungi discovered. The Red Rot of Sugarcane continues to receive attention and success is being achieved in the introduction of disease-free canes into affected tracts. Several new grasses have been discovered by one of the Assistant Economic Botanists and descriptions of these published.

WILLIAM BURNS,
Economic Botanist, Bombay.

APPENDIX G.

Report of the Agricultural Chemist for the year 1911-12.

1. The office and laboratory of the Agricultural Chemist to the Government of Bombay have been in my charge during the whole of the year under review.

2. The routine analytical work of the laboratory remains as great as ever. The following figures indicate the number of samples received in each of the last six years :—

Kind of sample.	Number of samples received.					
	1906-07.	1907-08.	1908-09.	1909-10.	1910-11.	1911-12.
Soils	67	101	311	347	281	378
Manures	43	105	91	205	184	195
Feeding stuffs	17	41	17	107	33	114
Water	22	80	266	403	328	362
Gul and sugar	32	76	7	56	10	5
Beet root	...	...	36	11	1	...
Oil seeds and oils	47	98	146	278	190	72
Milk	233	666	257	546	73	206
Condensed milk	...	...	2	...	1	...
Cream	123	1	1	...	...	...
Butter and ghee	2	2	2	16	12	...
Tapioca	...	...	...	46	9	...
Miscellaneous	10	22	17	104	94	91
Total ...	596	1,192	1,153	2,119	1,216	1,423

3. As in previous year by far the largest proportion of the samples were received from the various farms and offices of the agricultural department. There is a steady increase, to which I have referred in previous reports, in the use made of the laboratory by the public. I still maintain that this steady increase is really the test of the success of the work. So long as little else than departmental work is done, so long must it be considered that only half the purpose of the laboratory is being served. When, in addition, its utility is realised by the public, and samples of water, soil, oilcake, &c., about which some question has arisen is naturally sent to this laboratory, then I feel that it is much more adequately filling its proper function. The number of samples which have been received from private individuals and firms during the past five years is as follows :—

	1907-08.	1908-09.	1909-10.	1910-11.	1911-12.
Soils	15	14	23	59	81
Manures	12	11	11	73	54
Feeding stuffs	3	2	17	11	45
Water	11	16	15	38	31
Oil seeds and oils ...	...	...	...	...	20
Milk	...	4	17	2	7
Butter and ghee ...	...	...	13	10	...
Gul and sugar	...	...	...	...	4
Miscellaneous	...	...	41	56	34
Total ...	41	57	137	249	276

4. There has been considerable activity in connection with the development of a large scale oil-seed industry in the Bombay Presidency during the last year,—and I have been, as agricultural chemist, in touch, either directly or indirectly, with nearly all the mills which have been founded or are in the course of being established. Two mills are devoting their attention to the crushing of cotton seed oil,—the Indian Cotton Oil Co., Ltd., with factory at Nausari, and Messrs. Tata Sons & Co., at Kurla. Both of these have produced excellent refined oil, and also decorticated cotton seed flour and cake. The oil compares well with American refined oil, and the peculiar acid taste *said to be* characteristic of Indian oil has been entirely got rid of. With regard to the cakes and other products, I give below analyses of the cotton seed flour, cotton seed oil, and of biscuits made with wheat flour and cotton seed meal from the Indian Cotton Oil Co., Ltd. They are all excellent materials :—

	Cotton seed flour.	Cotton seed oil and wheat flour biscuits.	Cotton seed flour and oil biscuits.
	Per cent.	Per cent.	Per cent.
Moisture	2·43	3·04	3·30
Ether extract	15·10	7·40	10·10
Proteids	40·25	7·44	7·81
Carbohydrates	29·60	81·43	77·85
Woody Fibre	4·89	Trace.	·22
Ash	7·73	·69	·72
Total ...	100·00	100·00	100·00
Containing Nitrogen	6·44	1·19	1·25
Containing Sand	1·27	*Nil.*	*Nil.*

In connection with these materials two difficulties have arisen, first the fact that the loss in refining Indian cotton seed oil seems greater than authorities led us to expect, and second, the fact that the demand at present in India for the cake is very limited and most of it has to be exported. The former difficulty is a matter for investigation which is being taken up. The latter difficulty is a matter which only time and long continued efforts to teach the people the very great value of these cakes can solve.

Another seed which has been crushed on a large scale during the last year, and the crushing of which has been taken up by nearly all the new mills, is groundnut. The local demand for oil has been great enough to absorb all produced: the foreign demand for cake, chiefly from Marseilles and Liverpool, has been great enough to bring about an almost regular rise in price. The success of the new mills in crushing groundnuts has been very great, both cake and oil being high-class products. The cake produced has normally contained from 7 to 9 per cent. of oil, though samples have reached my hands containing as low as six per cent.

The very large and constantly increasing demand for vegetable oils has led to the discovery of a very large adulteration with deodorised mineral oil. The particular cases in which this has been noticed have been cocoanut oil and linseed oil. In the former case it is now practically impossible to get pure cocoanut oil in the bazar. A sample through our hands gave 57·6 per cent. of added mineral oil, and others have had not dissimilar figures. In linseed oil, we have found up to 20 per cent. of mineral oil. All our experience in this laboratory during the year seems to indicate that the increased demand for vegetable oils will lead to large adulteration, unless steps are taken to bring it into check at once.

5. A good many experiments have been made during the year to try and find a method of denaturing common salt which would allow it to be used near the coast for manurial purposes without paying duty. I referred to this matter last year, and showed that it was little use mixing it with pitch or coal tar, as an edible salt can be easily prepared from the mixture. When mixed with cowdung, likewise, it was found not difficult to prepare again a quite edible salt from the mixture. At this stage I was informed that the method adopted by the German Government was to simply mix the material with petroleum. The following is an extract from a letter from Messrs. Ernest Grether & Co., of Manchester, who were kind enough to supply me with this information.

> "We some time ago made enquiry as to the practice of the German Government where salt is sold free of duty for industrial purposes, and were informed that the salt as mixed was piled in heaps, the Revenue Officer then poured petroleum over it which was thoroughly incorporated by mixing: it was then issued free from restriction."

I have now tried this method in my laboratory here. It makes the salt quite useless for eating, but solution and evaporation over a fire still gets rid of practically all the petroleum, and we have succeeded in again preparing an edible salt from it. Though this is the most efficient practical method yet devised, it does not preclude the possibility of using the material for edible purposes. This would be done if a little nightsoil were mixed with the salt, but then, I am afraid, the people would not use the salt at all.

6. As an illustration of the very valuable manures which are lying about unused, I may refer to the composition of water weed termed '*Neel*' removed from a tank in Khed (Ratnágiri) where it was creating a nuisance. It contained an astonishingly high percentage of Nitrogen, and was a very rich manure. The following figures show the manurial value of the dried '*Neel*.'

Nitrogen	6·77 per cent.
Potash	1·98 per cent.
Phosphoric Acid	1·24 per cent.

Judged by composition alone, it was equal to a very high-class oil cake as a manure.

7. A very important question was raised by a series of samples of *mhowra* distillery effluent received from the Alembic Chemical Works at Baroda. This effluent was intended to be got rid of by turning it on to land,—but in doing so it created a nuisance and became a centre for an atrocious smell. There was, in fact, danger of the works being closed on this account. The whole cause of the difficulty, however, appeared to be the fact that the material was applied to the land in far too concentrated a form. As the qusetion of utilising similar refuse may occur elsewhere, I will quote the substance of my reply on this question.

"..... There is nothing in the material which would prevent its being utilised for the purpose of irrigating land.

In its present condition it is, however, far too strong to be utilised in this way and it is probable that this fact is the source of the difficulty which you have experienced, and the cause of the nuisance which is caused by the material.

To be of value for land treatment as irrigation material in fact, it should be diluted to from eight to ten times its present volume with ordinary river or well water, and if this is done it can then be used for irrigating sugarcane, ordinary garden vegetables and other garden crops, and in almost any other direction without causing any nuisance and with good agricultural results. The best way would be to allow the effluent to mix with the irrigation water on its way to the field in the necessary proportion (one to eight or one to ten), and good results will be thereby obtained."

8. A good deal of interest has always attached to the leaf manures of North Kánara manures which are said to be the cause of the success of the spice gardens of that district. Three samples were very kindly sent to me by the Honorary Secretary, Agricultural Association, Kumta, and gave results as follows. The analyses are calculated on the original material as sent from the gardens:—

	"Soppu" manure.	"Darku" manure.	Good "Darku" manure.
	Per cent.	Per cent.	Per cent.
Stones and stubble	2·5	.....	.....
Nitrogen	·67	1·22	·96
Potash	·66	1·39	·50
Phosphoric acid	·32	·20	·16

It is evident from these figures, which show them to be very ordinary refuse manurial materials, that their peculiar effect has yet to be accounted for. The value calculated by the usual methods, is not nearly so great as is actually found to be the case in practice.

9. Among the samples submitted most frequently for analysis are soils which are infertile or objectionable owing to the presence of salt. In the sugarcane tracts this condition of things often shows itself earliest in a deterioration of the quality of the "*gul*" or jaggery made from the cane. An example occurred in the case of sugarcane grown in the village of Chebbi (Dhárwár District). Here, in the cane itself, no less than 31 per cent. of the total sugar was uncrystallisable, while the cane contained salts as follows:—

Sodium Chloride	·53 per cent.
Sodium Sulphate	·30 per cent.
Sodium Carbonate.	·16 per cent.
Magnesium Sulphate	·58 per cent.

Inasmuch as the salts in the soil and irrigation water had brought about this result in the cane itself, it was impossible to recommend any change in the methods of boiling which would give a higher quality *gul*. The only method would be to drain the land, and then either apply a less salty water or ensure that it passes rapidly through the soil by drainage. That this is not a rare case was shown by the occurrence of a case precisely similar in the immediate neighbourhood of Poona.

10. But land containing an objectionable amount of salts is common not merely in connection with sugarcane cultivation or even in connection with irrigation, but on land of all sorts especially in the southern part of the Presidency. Under the name of '*karl*' spots of infertile land are found over a large part of the Southern Maratha Country, and their infertility can often, though not always, be traced to the presence of salts of one sort or another. The following determinations of the amount of salt in such soils and its composition, supplied by Rao Saheb M. L. Kulkarni, from the Bijápur District, may be of interest.

	No. 1 Indi village.	No. 2 Baglore village.	No. 3 Managolli village.	No. 4 Karjagi village.
	Per cent.	Per cent.	Per cent.	Per cent.
Total Soluble Salts	·16	·49	2·10	·54
Containing—				
Calcium Carbonate	·02	·07	·02	·02
Calcium Sulphate	...	...	·27	·03
Magnesium Carbonate	·06	...	...	...
Magnesium Sulphate	·02	·01	·17	·15
Sodium Carbonate	·02	...	...	·02
Sodium Sulphate	·03	·33	·77	·24
Sodium Chloride	·01	·08	·87	·07

The only way of reclaiming such *karl* land is by careful bunding and drainage—and even this is a slow business in the black soil of the Deccan.

11. These are just a few samples of the kind of problem which are now continually coming before me, and I only quote them as such. The laboratory is being used to a continually increasing extent for inquiries regarding such problems.

12. At the same time as my laboratory tries to examine and advise in connection with samples which are sent in for such examination, equally important is the work done on investigations originating here. During the past year such investigations have been actively continued. The first paper on the study of the '*rab*' system of rice cultivation has been published as a Memoir of the Department of Agriculture in India. The work on this subject is being continued. During the year also a paper (in conjunction with Mr. A. A. Miggett) on the composition of the milk of Indian buffaloes has been completed and is now in the press. A long paper on the agricultural well waters of the trap area, based on a regular study of these from selected places extending over more than four years is nearly ready for publication, and the investigation will be continued.

The research work, beyond that already indicated, now in progress is in summary as follows :—

(1) A study of the chemistry and physiology of the betel vine leaf, and of the process of bleaching it, with a view to improvements in the method of dealing with this, the most important garden crop of the Presidency. This is being carried out in conjunction with my assistants Messrs. D. L. Sahasrabuddhe, B. Sc., L.Ag., and V. G. Patwardhan, B.Ag.

(2) A study of the properties of safflower oil, one of the chief oil seed products of our driest areas,—more particularly with reference to its larger utilisation as a drying oil. This is being carried out in conjunction with my assistant Mr. N. V. Kanitkar, B.Ag.

(3) A continuation of the work already published on the '*rab*' system of rice cultivation, including especially the consideration of the question of the modification of the texture of soils.

(4) A continuation of the study of the salt and *karl* lands on the black soil of Western India, and their reclamation. Progress is being made in all these directions.

13. My staff suffered a serious loss during the year by the transference of Mr. B. B. Price, Senior Laboratory Assistant, to Dacca to occupy a similar position under the Eastern Bengal and Assam administration. Mr. Price was an excellent worker and an accurate analyst,—and I regret his loss. His place was taken by Mr. V. A. Tambane, L.Ag., and the latter's place as Junior Laboratory Assistant was taken by Mr. V. G. Patwardhan, B.Ag.

HAROLD H. MANN.

APPENDIX H.

Report of the Agricultural Engineer for the year 1911-12.

General.

During the past year the interest shown by the agricultural classes in the various matters which come under the heading of Agricultural Engineering has continued to spread rapidly and has resulted in a great number of enquiries and requests for the advice and assistance of this department.

Pumping Department.

Irrigation by pumping from rivers or wells continues to excite most interest and the enquiries in this direction show a steady increase over last year.

This particular branch of work may be expected to increase year by year, as each pumping plant installed will lead to others and to enquiries as to their possibilities.

Pumping will always be the most important subject to be developed by this department.

It is satisfactory to be able to record that owners of wells at present using cattle water lifts are beginning to consider the substitution of engines and power-pumps.

A large number of enquiries has been received this year from such sites, but as mentioned in last year's report only a few wells prove to be capable of supplying sufficient water to keep a 3″ centrifugal pump at work regularly.

Hitherto the 3″ pump was the smallest that could be recommended, as the next size smaller—the 2″ certifugal, was a very inefficient machine.

New Pumps.

I have now persuaded the makers, Messrs. Gwynne, to place on the market a 2½″ pump giving about two-thirds the discharge of a 3″ pump, and this being much better designed than the old 2″ pump, its efficiency is almost as good as that of the 3′ pump and it can be recommended as a satisfactory machine. The use of this pump (whose discharge is equal to about 4 mhotes) will probably bring many wells within the range of successful and economical pumping.

I have also persuaded Messrs Gwynne to re-design all their standard sizes of pumps with a view to obtaining a higher efficiency within the limits in which they are generally worked for irrigation pumping.

They have now placed on the market, at the same price as the old type pumps, a much improved high efficiency low lift pump which is admirably suited for irrigation work, on lifts up to 65′.

There are numbers of other good pumps on the market, such as the Ruston, Proctor, the Pulsometer, etc., but in placing my orders I find it is best to keep to one maker and thus make it worth their while to study my requirements, and to keep a large stock of spare parts as well as of the different sizes of pumps likely to be required. Pump sites on rivers and nullahs with some perennial flow offer the best possibilities for irrigation, especially on those where the lift is not very great, and flood conditions are not too severe. Particulars of enquiries received and of plants erected during the year will be found later in the report.

Boring Department.

Cawnpore Tools.

The matter of next importance to pumping, at present, is probably that of boring in wells, to increase water-supply by tapping springs or artesian water.

In Gujarát, where great depths of various soils and sands overlie the rock, a large number of bore holes have been sunk with sets of Cawnpore tools, by the staff under the Deputy Director of Agriculture.

It is now proposed to hand over this work to the Agricultural Engineer as the operations have attained such magnitude and importance as to need the attention of an engineer, in order to obtain the best possible mechanical efficiency from the tools being used.

Thirty sets of tools belonging to this department were at work during the past year, and about 45 other sets belonging to Local Boards, etc.

A great number of boreholes have been sunk in existing wells by this staff with very satisfactory results, the water-supply in many cases being very greatly increased.

The Deputy Director gives interesting details of this work in his annual report.

It will be noticed that the severe drought of last season gave a great impetus to these operations, and if a good rainfall is obtained this year there will probably be a considerable falling off in the demand for borings, or at least no further increase; but a considerable permanent demand may be anticipated, and in the course of years should do much to lessen the risk of famine in dry season. The work done by the Cawnpore tools as at present used is laborious and slow, and it is hoped to make considerable improvements in the tackle whereby faster and cheaper work may be done.

Power driven boring plants.

It is also proposed to try power driven boring plants for this work, and such plants will have the advantage of being able to drill through rock or any formation where necessary.

One such plant has now been ordered for the use of the Kaira District Local Board, and if successful, it is proposed to purchase others for the use of this department in any part of the Presidency.

Sixteen enquiries were received for plants capable of boring through rock, from all parts of the Presidency, and if a successful machine is found, with which bores can be sunk at a reasonable cost, there is not the least doubt that many more people will come forward who need it, and that constant work can be found.

The core drill is a very good type of machine where specimens of the strata are required, or where only solid rock is encountered, but it is not well suited for work in soils, and it is hoped that a much more satisfactory type of machine will be obtained, which will bore quickly in soil and can also bore rock at a good speed.

Blasting in Wells.

Five enquiries on this matter have been received. Advice has been given, but no staff has yet been engaged for this work.

When the power boring plant has been purchased it will be possible to make useful experiments with torpedoes in the bore holes, but until such a plant is available there is little use and much danger in trying torpedoes.

Steam Ploughing.

Another very important matter which is beginning to excite a good deal of interest is that of ploughing and cultivating land by means of power driven implements.

During the year under review enquiries were received from six large land owners who were contemplating the purchase of plants, five others having been received last year.

The initial outlay necessary for the purchase of steam ploughing tackle is very high, and hardly anything is known about the subject by the people of India.

Hence there is a very natural hesitation, on the part of those interested, to embark in such an enterprize.

I consider this matter is the most important problem yet proposed for solution in connection with improvements in agricultural methods, and I would strongly urge Government to demonstrate the possibilities of steam ploughing, by working a plant departmentally for some years.

In the hope of furthering this scheme and of spreading some information on the subject, among those interested, I have prepared a "Note on Steam Ploughing," a copy of which is attached to this report.

The note will be published as a Departmental Bulletin for the convenience of the general public who may be interested.

Pumping Enquiries.

The total number of enquiries received and answered was 82, divided among the divisions of the Presidency as under:—

Southern Division	32	enquiries.
Central „	13	„
Northern „	27	„
Sindh	3	„
Native States	7	„
Total ...	82	

The Southern Division, particularly the Belgaum and Bijápur Districts, offers by far the best sites on rivers and nullahs, and the prospects of lift irrigation are most hopeful here, as the prevailing lifts are fairly small.

The enquiries from the Central Division are about equally divided between river and well sites.

The river sites are generally poor, with very high lifts, heavy floods, and hilly land.

The lifts from the wells are fairly low, but the quantity of water very limited in most cases.

Nearly all the enquiries from the Northern Division are for well sites.

The quantity of water is generally rather limited and the lifts very high—from 50′ to 90′, but as it is found profitable to lift water by indigenous methods, the substitution of power pumps would in many cases be advantageous, from the point of view of both speed, convenience and economy.

The total number of pumping enquiries attended to in the previous year was 85, but of these many were old enquiries left unanswered by my predecessor and only discovered by later references.

A bound leaflet giving the principal features to be considered in Pumping Projects, and the procedure adopted by this Department in undertaking the erection of pumping plants for private cultivators, is being printed in English and Vernaculars for the use of district officers and the cultivators.

Sugarcane Crushers.

(*a*) Seven enquiries have been received during the year, asking advice and particulars of cane crushers.

None of these have, so far, led to practical results chiefly owing to the enquirers lacking the necessary capital.

It is believed that two at least will mature and result in the purchase of plants.

(*b*) One of these will be quite a small plant capable of crushing about a quarter of an acre of cane per day and it is proposed to work the crusher by a 6½ B. H. P. oil engine which was fixed a year ago at Sulla, Bijápur District, by this department, to drive a centrifugal pump.

This pump is providing water for irrigating the cane, so that if a crusher is installed the owner will have a very nice complete little plant.

(*c*) The other plant is a very large one (for this country) capable of supplying juice for 100 pans per day.

(*d*) One enquiry during last year was expected to mature and the enquirers had practically decided to erect a plant near Násik, but at the last moment there was a difficulty about money, and the famine conditions of the district led to the abandonment of the scheme.

Windmills.

Five enquiries were received and estimates given for windmills.

One has been erected and another is probable.

General information regarding Agricultural Machinery.

About a dozen enquiries of a general nature were received and answered.

The total enquiries on pumping, boring, ploughing, and general matters, answered during the year, was about 135.

The plants now owned by Government are as under.

Málegáon, Poona District, 25 B. H. P. oil engine and cane crusher.

Mánjri Farm, Poona District, 18 B. H. P. oil engine and cane crusher.

Nangaon, Poona District, 37 B. H. P. Suction Producer Gas Engine driving 10″ and 15″ turbine pumps.

Ganeshkhind, Botanical Gardens, Poona District, 8 B. H. P. oil engine and 3″ centrifugal pump.

Dhárwár Farm, Dhárwár District, 6½ B. H. P. oil engine, one 2″ centrifugal pump, one 3″ rotary pump, one cotton gin.

Surat Government Farm, Surat District, 6½ B. H. P. fixed oil engine and 2½″ rotary pump, cotton gin and chaff cutter.

Also to be erected 6½ B. H. P. Portable engine and several 2½″ centrifugal pumps on wells.

Nadiád Government Farm, Kaira District, 6 B. H. P. oil engine and 3″ rotary pump.

Gokák Farm, Belgaum District, 14 B. H. P. oil engine, cane crusher, and 3″ centrifugal pump.

The two pumping plants at Ghotovda, Poona District, have been sold to the owners of the land on which they are fixed.

WORKS COMPLETED OR UNDER CONSTRUCTION DURING THE YEAR.

Government owned.

Nangaon, Poona District, 37 B. H. P. Suction Producer Gas Engine driving 2 large Turbine Pumps and 2 small reciprocating pumps (completed).

Gokák Farm, Belgaum District, 14 B. H. P. oil engine, sugarcane crusher, and 3″ centrifugal pump (under contruction).

Godhra, Panch Mahals District, small windmill and pump (completed).

Málegaon, Poona District, 26 B. H. P. oil engine and large cane crusher (re-erection completed).

Privately owned.

Turmuri, Belgaum District, 8 B. H. P. oil engine and 3″ centrifugal pump (completed).

Neginhal, Belgaum District, 8 B. H. P. oil engine and 4″ centrifugal pump (under construction).

Dhulia, West Khándesh District, 10 B. H. P. oil engine driving 3″ centrifugal pump and 2½″ centrifugal pump, also eventually 3 cotton gins (under construction). Engine and 3″ pump completed.

Biludi, East Khándesh District, New 10 B. H. P. oil engine in place of 6½ B. H. P. oil engine driving 4″ centrifugal pump.

Longer lead and greater lift required (under construction). Eventually 2 cotton gins will be installed.

Turmuri, Belgaum District, 20 B. H. P. oil engine and 6″ centrifugal pump (under construction).

Aukli, Belgaum District, 22 B. H. P. oil engine and 4″ Vertical Spindle Centrifugal Pump (under construction).

WORKS TO BE UNDERTAKEN IN THE COMING YEAR.

Completion of all works now in hand.

Also plants as under :—

Surat Government Farm, 6½ B. H. P. Portable oil engine to drive several 2½″ centrifugal pumps fixed in different wells on the farm.

Agricultural College Farm, Poona, erection of various types of water lifts on the experimental well on the farm.

Mánjri Farm, Poona District, erection of new power juice pump.

There will also probably be several other private owned pumping plants as the year proceeds, as under :—

Neginhal, Belgaum District, 6½ B. H. P. Portable oil engine and 3″ pump.

Bhendigiri, Belgaum District, 10 B. H. P. oil engine and 4″ centrifugal pump and others.

Crushing plants probable.

Sulla, Bijápur District, small cane crusher to crush a quarter acre of cane per day.

(Engine already erected, driving 4″ pump.)

Nampur, Násik District, large steam engine and cane crusher to crush 7 acres of cane per day.

Nangaon Pumping Plant.

This plant has several features which are novel among irrigation pumping plants in this Presidency and I believe in all India.

In the first place expensive turbine pumps were used in order to obtain high efficiency, *i. e.*, a large delivery of water with small power.

The method of fixing or arrangement of the plant is also unusual.

The flood conditions at this site on the Bhima River are very severe, the highest floods rising as much as 40′ feet above low water level.

Unfortunately the tract of country around Nangaon is peculiarly rainless and is frequently without any rain when surrounding tracts are getting heavy falls.

The greater part of the flood water in the Bhima comes, of course, from the hills at its source, and the high floods at Nangaon frequently occur, and may last days or weeks together, while there is no rain whatever in the village.

It is therefore necessary to be able to pump during any stage of the river, that is, throughout a total fluctuation of 40 feet.

In the few cases where similar conditions have been handled before, the usual practice has been to fix the pump or pumps in a well constructed in the high bank of the river and connected to the river by a pipe or masonry culvert.

The difficulty and cost of making a well 50 feet deep in black cotton soil is very great.

The pipe or culvert would also have been long and expensive, as the well would have been some distance from the river and it would be likely to give trouble by silting.

To avoid these difficulties and to endeavour to find a cheaper and satisfactory solution for other similar cases, I decided to experiment with an entirely different arrangement of the plant.

The engine was fixed quite near the edge of the river bank, and within the area covered by the highest floods.

The foundations of engine and engine-house were built up to such a height as to be just above highest flood level, and an embankment or platform of earth made all round the engine-house to protect it from the floods.

On the very edge of the high bank a countershaft was fixed, also above flood level, of which the foundations were supported by steel piles driven about 15 feet below the ground and buried at the top end in the concrete of the foundations.

Half way down the river bank an excavation was made into the side of the bank and protected with retaining walls at back and sides.

Buttresses were also built from the top of the retaining walls, up to the foundations of the countershaft, to give the latter further support.

Within the space so enclosed one set of pumps was fixed.

The suction pipes of these pumps were then laid along the sloping bank and carried down into the river to a point about 4 feet below the lowest water level.

At lowest water level the suction lift on these pumps will be about 18 feet to 20 feet.

Their delivery pipes are taken up the bank, under the countershaft, and on to a distributing tank built on the high ground above flood level.

A belt from the engine drives the countershaft and another belt from the countershaft drives the pumps below.

So far the design is simple, but these lower pumps can only work so long as the river does not rise more than 18 feet above its lowest level.

As soon as it rises higher the pumps are submerged and can no longer be worked by the belts.

Yet it is necessary to continue pumping water up to the land.

To do this, another set of pumps is fixed on the high bank alongside the engine-house.

The suction pipes of these pumps pass under the countershaft and down the sloping bank of the river to a point about 3 feet below the pulleys of the lower pumps.

Thus before the water rises up as far as the lower pumps the footvalves of the upper pumps are under water and these pumps then can be used.

The maximum suction lift of these pumps is 20 feet.

They are driven by belts from the same countershaft that drives the lower pumps.

The procedure is therefore very simple.

The lower pumps are worked during the hot weather and during the earlier or smaller floods; while the upper pumps are idle.

As soon as the floods rise above the footvalves of the upper pumps, the belts driving the lower pumps are removed, and changed on to the other pulleys to drive the upper pumps.

These upper pumps can then work right through the medium and highest floods, until the water subsides again below the lower pumps, which will then be again used, after cleaning.

The whole plant was completed in January of this year, but unfortunately has not yet been used in regular work for irrigation, owing to the distribution channels being not yet finished by the Public Works Department, which is responsible for the distribution of the water.

A number of test runs have however been made, and the pumps have been kept at work for some days. Fortunately very heavy floods have occurred this year (in July) and have enabled the plant to be thoroughly tested.

The upper pumps were kept at work for some days and proved thoroughly satisfactory.

The floods, which were the highest on record, rose to within 9 inches of the floor of the engine-house, or about 18 feet above the lower pumps, and remained above the latter for a considerable period, during which there was little or no rain, and pumping would have been necessary for irrigation.

After the flood had subsided the lower pump enclosure was full of silt, which was easily and quickly removed by hand.

The pumps were then cleaned and again put to work within a day.

Everything stood the flood excellently, without the least damage, and the arrangements may be considered thoroughly satisfactory.

From the flood records for past years it is known that the upper pumps would have been at work in those years for periods varying from 2 days to 2 months according to the floods.

With this plant it is hoped to irrigate eventually about 700 acres of land, with sugarcane and garden crops, etc., on a 3-year rotation.

The land is almost always famine-stricken owing to the very poor rainfall, so that this should form an excellent demonstration of what can be done by lift irrigation even under the most severe conditions of lift and flood, etc.

Below are given actual figures for the cost of the Nangaon plant, and also for another plant fixed privately at Ranjangaon, on a well in river bank, as described. (The usual method adopted.)

The latter plant is only a few miles from Nangaon, on the same river, and under almost identical conditions, except that the total lift in the latter case is only 43 feet, as against 47 feet at Nangaon.

Nangaon Plant.

37 B. H. P. Suction Producer Gas Engine driving,

Lower pumps (*a*) 10″ Turbine pump and small reciprocating pump;
or Upper pumps (*b*) 15″ Turbine pump and small reciprocating pump.

Total lift 47 feet.

Delivery (*a*) *Lower Pumps.*

75,000 + 2,000 gallons per hour equal to 77,000 gallons per hour.

Total lift 30 feet.

Or (*b*) *Upper Pumps.*

114,000 gallons per hour + 2,000 gallons per hour equal to 116,000 gallons per hour.

Note.—The upper pumps require slightly less power than the lower pumps, although the discharge is so much greater.

This is due to the smaller lift and the fact that the pumps are properly designed for their work.

	Rs.	
Cost of all machinery, piping, erection, and appliances, including large stock of spares, and 1,000 feet of steel fencing ...	= 18,000	
Cost of all work for fixing and housing machinery and servants' quarters	4,200	19 per cent. of Total Cost.
Total Cost ...	22,200	

Annual working expenses for 350 days per annum, 10 hours per day, including interest, depreciation and repairs ... 6,000 per annum.

Ranjangaon Plant.

25 B. H. P. oil engine and 5″ Centrifugal Pump, Total Lift 43 feet, Delivery 30,000 gallons per hour.

	Rs.	
Cost of all machinery, piping, and erection, with a few spares only	5,000	
Cost of all work for fixing (well culvert, etc.) and housing machinery	9,000	equal to 64 per cent. of total cost.
Total Cost ...	14,000	

Annual working expenses for 350 days per annum and 10 hours per day, including interest, depreciation and repairs ... =5,900 per annum.

It will be noticed from these figures that the cost of all work (masonry, foundations, etc.), for fixing and housing the machinery, as well as for servants' quarters, at Nangaon, amounts to only Rs. 4,200 or 19 per cent. of the total cost of the plant, whereas the corresponding expenses at Ranjangaon are Rs. 9,000 of 64 per cent. of the total cost of that plant.

Also that the cost of this work at Ranjangaon (Rs. 9,000) is more than double the corresponding cost at Nangaon (Rs. 4,200) for plant giving one-third the quantity of water obtained at Nangaon.

The arrangement of the plant at Nangaon is at least equally as satisfactory as that at Ranjangaon (if not more so), and it may therefore be claimed that the former system is greatly preferable to the latter, owing to its much lower cost.

This was the object of the new design.

Now considering the cost of machinery and the annual working expenses, it will be noticed that the total cost of working per annum, including liberal allowances for interest, depreciation and repairs, is Rs. 6,000 for the Nangaon plant, and Rs. 5,900 for Ranjangaon.

The quantity of water obtained at Nangaon throughout the hot weather is 2½ times that at Ranjangaon and when the upper pumps can be worked this is increased to nearly 4 times the supply at Ranjangaon.

The cost of the water at Nangaon is therefore only 40 per cent. of the cost at Ranjangaon.

This result is obtained by using more expensive and much better designed pumps and engines, but it is evident that the extra expenditure is amply justified by the results.

As a matter of fact the expenditure at Nangaon might have been considerably less, but no expense was spared to make a thoroughly complete and model plant.

Out of the Rs. 18,000 expended on machinery, spares, appliances, and steel fencing, at least Rs. 2,000 was spent on the latter items, in order to insure excellent results.

Similarly the works for fixing and housing are very thorough and complete, including stone pitching on all the embankments and on the bank of the river itself, and pukka brick trenches throughout the engine and producer houses, for all piping, etc., as well as concrete floors.

By cheaper construction the cost of Rs. 4,200 for these works could have been considerably reduced.

The whole plant is a higher class of engineering work than that at Ranjangaon, although the latter is also a good work.

An important point to notice however about the Nangaon system is that its success depends entirely upon the plant being properly designed, and accurately fixed in a good engineering manner.

Survey and Inspection Tours.

During the year I have again had a great deal of touring to do spreading all over the Presidency proper, and also to Sind.

Part of this touring was in connection with my Agricultural duties and part for the inspection of Municipal and State Water-works for the Sanitary Engineer to Government.

The latter work, and reports thereon, as well as advice and selection for new Water-works plant, has occupied a considerable portion of my time, 16 existing plants being inspected and reported on, several being tested, and a number of new works considered.

I was absent from India on privilege leave for three months from August to November, and while in England spent about five weeks in touring round the country (at my own expense) to see various uptodate Water-works and Sewage works, and also to inspect steam ploughing plants at work in different countries.

During the nine months of the year which were spent in India I visited about 100 towns and villages all over the Presidency, most of these visits being for the purpose of surveying pumping sites for irrigation, of which some particulars were given, under the head of Pumping Enquiries.

Staff and Establishment.

During the year various changes and increases have been sanctioned by Government, and provision is now made for sufficient staff to deal with all the work in hand.

Some of the sanctioned posts still remain to be filled, and men will be appointed as suitable applicants appear.

Mr. C. G. Paranjpe joined my staff as Mechanical Superintendent in January last and has proved very painstaking.

His work is commendable and he should in time, after further experience, become a valuable member of the department.

A second Mechanical Superintendent is shortly to be appointed, who will share with Mr. Paranjpe the duties of superintending and directing the work of the fitters.

Later on they will probably be taught to survey and select suitable pump sites, etc., and thus save the Agricultural Engineer a great deal of touring for this work.

Of the fitting staff, Mr. Pednekar has done very good work. He is a good mechanic and does his work accurately and well, although he is rather slow.

In the office, good work has been done by the Head Clerk, Mr. Joshi, who has shown much industry and care, with the accounts and correspondence.

A. A. MUSTO,
Agricultural Engineer.

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46	1911	Seed Selection Series, I. Broach Cotton, by T. Forster Main, B.Sc., Deputy Director of Agriculture, Bombay Presidency, Poona	0 6 0
47	1911	San Hemp (Crotolaria Juncea), Tág (Maráthi), by P. C. Patil, L.Ag., Divisional Inspector of Agriculture, C. D.	0 4 0
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51	1912	Third Year's Experiments in the Treatment of Grape-vine Mildew in the Bombay Presidency, by W. Burns, B.Sc. (Edin.), Economic Botanist to the Government of Bombay, and G. B. Patwardhan, B.Sc. (Bombay), Assistant Economic Botanist	0 3 0
52	1912	Muscovado Sugar Machinery and its scope for *Gul* manufacture in India, by G. N. Sahasrabuddhe, L.Ag.	0 8 0
53	1912	A Method of improving the Quality of Cotton Seed, by G. D. Mehta, B.A., L.Ag., N.D.A., N.D.D., and V. G. Gokhale, L.Ag.	0 7 0